Circularity Assessment Protocol
Dominica

University of Georgia
Circularity Informatics Lab
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New Materials Institute
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Executive Summary

Developed by the Circularity Informatics Lab (CIL) at the University of Georgia, the Circularity Assessment Protocol (CAP) is a standardized assessment protocol to inform decision-makers through collecting community-level data on plastic usage. Grounded in materials flow and systems thinking concepts, the CAP uses a hub-and-spoke model to holistically characterize how consumer plastic flows into a community, is consumed, and flows out, either through waste management systems or leakage into the environment. The model, shown below, is comprised of seven spokes: input, community, material and product design, use, collection, end of cycle, and leakage. At the center, the system is driven by policy, economics and governance with key influencers including non-governmental organizations, industry, and government.

In April and October 2023, a team member from CIL conducted CAP fieldwork in Dominica with guidance and support from the Dominica Solid Waste Management Corporation (DSWMC) and with assistance from students of the Dominica State College. Funding and support for the fieldwork was provided to CIL by Dynamic Planet. Field work included product and packaging assessments in stores across the country; key stakeholder interviews with government, industry, and non-profit organizations; material type characterizations for consumer plastic items; cost analysis of reusable products and alternatives to plastic available in the country; visual audits of

recycling contamination; identification of public waste and recycling collection bins; litter transects in three categories of ambient population density; environmental assessments of plastic pollution in waterways, on beaches, and in nearshore waters. Key findings from each spoke are summarized in the table below.

Key Findings and Opportunities

INPUT 	**Findings:** In total, 225 unique brands of convenience products were collected and sampled from 37 convenience stores across Dominica. Among all of the five convenience product categories (beverages, candy, chips, tobacco, and biscuits/wafers), each had at least one manufacturer that was located domestically in Dominica. The United States, Trinidad & Tobago, and Jamaica were among the top importing countries for convenience products. Across all product categories, Dominica-based operations represented around 6% of the market both among manufacturers and parent companies. Opportunities exist to enhance local manufacturing and business opportunities and to mobilize regional partnerships for extended producer responsibility (EPR), product redesign, and takeback schemes. **Opportunities:** ● Adjust Dominica's SUP import ban and policy to be based on the type of polymer or resin code instead of the product labeling to ensure non-biodegradable or non-compostable items are not being imported; support enforcement mechanisms and polymer testing infrastructure ● Target key importing countries for FMCGs, such as the United States, Trinidad & Tobago, and Jamaica, for potential extended producer responsibility or collaborative waste collection and recycling options, particularly for the most problematic plastic items such as films ● Explore opportunities to bottle local spring water, including revisiting infrastructure proposals from pre-Hurricane Marina, or increase production from local operations such as Trois Pitons to reduce bottled water importation from other parts of the Caribbean
COMMUNITY 	**Findings:** Semi-structured interviews were conducted with 28 key stakeholders, including local government officials, students from the local university, private companies (including tourism operators), community leaders, non-profit organizations, private store owners, and private restaurant owners. Interviewees expressed general support for the single-use plastic (SUP) ban in Dominica and for increased opportunities around recycling. There was a unanimous need to increase education, outreach, and consistent messaging to the public and to businesses around waste separation, particularly at key events (e.g., music and cultural festivals) and through existing popular channels (e.g., radio shows and social media). Interviewees expressed the importance of making changes affordable and convenient and stressed that messaging and incentives need to be able to reach all consumers, not only those who care strongly about the environment or nature. **Opportunities:** ● Strengthen existing solid waste and SUP policies and legislation within Dominica, including but not limited to Utility Fees and the Litter Act and associated fin structures - complement this with learning exchanges with other Caribbean nations that have implemented SUP bans, such as Saint Kitts & Nevis and Antigua & Barbuda

	• DSWMC could host a formal national campaign around sorting household waste at source, taking learnings from the Kalinago Zero Waste pilot • Bolster public education and awareness (including school programs, cleanups, regular radio shows, cultural events, billboards) particularly around littering and environmental preservation, with ties to messaging around protecting the Nature Island, and ensure this is extended to visitors and tourists • Develop clear messaging around the disposal of compostable plastics that can be targeted for restaurants, the general public, and tourism operators/tourists • Provide additional support, budget, and staff for marketing, education, and outreach around solid waste management through DSWMC • Consider hosting a Caribbean-wide convening to share SWM best practices, network across groups, and identify shared goals for INC; this could be conducted through OECS, CARICOM, or other existing networks • Incorporate data around ties to litter, pollution, and human health into public communication, potentially in collaboration with the Ministry of Health
PRODUCT DESIGN 	**Findings:** In addition to the 225 convenience items, 108 to-go foodware items were sampled from 40 restaurants and food vendors across Dominica. Convenience product packaging was dominated by multilayer plastic film and PET plastic bottles. The largest proportion of material for to-go foodware was PLA, an industrially compostable plastic, followed by fiber and non-coated paper, reflecting the influence of the SUP import ban. In addition, 9 large grocery stores across the island were surveyed for the material type of packaging of several key household items: Cooking Oil, Eggs, Greens, Laundry Detergent, Milk, Rice, and Sugar. Nearly 50% of all household items sampled were packaged in single-layer plastic bags, followed by those packaged in PET and HDPE. Difficult-to-recycle products such as plastic film could be targeted for product redesign, EPR, bulk/reuse options, or elimination, while recyclable items could be targeted for collection and effective end-markets. Compostable plastic also needs to be handled appropriately, as it will not break down naturally in the environment. **Opportunities:** • Consider an updated labeling process, particularly for different types of plastic items, to reduce confusion among consumers and reduce contamination of sorted waste streams - this includes guidance on the packaging related to disposal (e.g., chasing arrows symbol vs. recirculate symbol), which may also require regional discussions and collaborations with manufacturers and importers to ensure harmonization and consistency • Develop incentives and opportunities for expansion of local businesses in SUP alternatives, particularly for foodware, to reduce the reliance on imported goods to meet the needs of the SUP ban • As the most abundant material type among FMCGs, PET bottles and multilayer plastic film could be targeted for product redesign, reuse, or recycling opportunities • Capitalize on lessons learned from other Caribbean and island nations on product design and disposal innovation that has been successful

USE 	**Findings:** Among the 9 large grocery stores that were surveyed, 107 individual SUP and plastic alternative items were identified in the categories of sandwich bags, cups, food containers, plates, utensils, straws, and shopping bags. The most common single-use grocery bag distributed was black plastic labeled "biodegradable LDPE," which is likely in fact oxo-degradable. Alternative (biodegradable, compostable, alternative material, reusable) household items were unanimously more expensive than single-use plastic options. Many of the alternative brands that were identifiable were imported from the United States, China, the United Kingdom, though there is also a market within Dominica that could be expanded upon. Several countries, including the United States and China, were also found to continue importing standard single-use plastic options. Opportunities exist to strengthen the SUP import ban and other policies and legislation to provide viable and affordable SUP alternatives, grow the local economy, decrease dependence on foreign imports, and increase waste diversion from landfill. Local efforts around the circular economy could also bolster jobs and skilled workers on-island. **Opportunities:** ● Expand upon technology and social media rewards, similar to the WePlanet model, to encourage consumers to bring reusable items - this should be adopted and encouraged by local manufacturers, grocery stores, convenience stores, and food vendors ● Foster business opportunities domestically around reuse models and alternative materials, as well as investment and local capital to support those initiatives - this could include washing/reuse services, development of new SUP-free materials, bottle collection and deposit schemes, government subsidies, or local collaborations for on-island bottling, or otherwise ● Explore opportunities for reusable alternatives or increase the collection and recycling for local juices ● Expand the current SUP import ban to fossil-based plastic grocery bags based on polymer and not based on labeling ● Develop messaging to address community concerns around reuse and refill models, potentially in collaboration with the Ministry of Health, and ensure operations are hygienic, safe, and sustainable
COLLECTION 	**Findings:** Investigation into waste collection methods was conducted through stakeholder interviews, site visits to waste collection sites, and reviews of existing waste characterization and related literature. While Dominica has a relatively low per capita waste generation rate compared to other parts of Latin America and the Caribbean, it has a comparatively higher percentage of plastic in the waste stream, presenting challenges for waste diversion and recycling. Coverage for household waste collection across the island is high, but more infrastructure may be needed to ensure waste is properly transported and disposed of after pickup. Household waste sorting and providing source separation waste bins will be important for maximizing diversion from the landfill. **Opportunities:** ● Incentivize and develop clear infrastructure (e.g., marked or colored bins) to support household separation of waste that can maximize recycling, composting, and landfill diversion ● Ensure strategic and segregated collection infrastructure for key events on-island, such as local holidays, cultural events, festivals, and others ● Explore funding options to obtain new collection infrastructure, such as additional collection trucks and potentially transfer stations across the island to decrease the likelihood of trucks dumping waste inland and in ravines ● Take lessons learned from other Caribbean nations (such as case studies from Aruba) on ways to address C&D waste, potentially by developing a dedicated

	landfill or collection area for that type of waste on the island, creating local business opportunities around recycling and repurposing of that waste, or others; similar solutions could be explored for addressing derelict automobile waste in Dominica ● Where possible and appropriate, expand upon the household collection model used in the Kalinago Zero Waste pilot to maximize source separation and diversion ● Explore the possibility of engaging the cruise ship sector and potentially other trade sectors in transporting recyclable waste either back to mainland ports with enhanced solid waste management infrastructure or to other islands with complementary infrastructure in attempts to reach regional economies of scale
END OF CYCLE 	**Findings:** The one landfill in Dominica, Fond Cole, is rapidly reaching capacity and only has around 15 years of capacity left if the current expansion is completed. Efforts should be focused on waste diversion away from landfill and optimizing reduction, reuse, recycling, and composting options. Key infrastructure is needed locally, such as a material recovery facility, along with end-markets for waste that could be shared regionally to reach economies of scale. The Kalinago Zero Waste pilot has provided a strong example for household source separation, messaging and outreach, and incentives that can help reduce the amount of waste sent to landfill. There are also key opportunities to align solid waste management (SWM) with local business, tourism, disaster preparedness, and climate resilience. **Opportunities:** ● Develop a National Action Plan to strategize around and prioritize interventions for waste reduction, waste management infrastructure, community outreach and education, alternative materials, business opportunities, and other actions to increase Dominica's circular economy ● Explore funding opportunities for priority SWM infrastructure needs that would contribute significantly to waste diversion, such as industrial composting and/or anaerobic digestion, material recovery facilities, crushers and balers, and others ● Focus funding and resources towards opportunities for waste diversion away from the landfill and away from methods or technologies that may create additional waste or unintended environmental or health consequences, including continuing with and expanding upon the Recycle OECS pilot ● Engage with other Caribbean countries on opportunities for shared recycling markets, shared waste processing infrastructure (e.g., tire shredders, glass crushers, etc.) and economies of scale - this could be started with other countries that have conducted similar analyses and/or are going through similar recycling pilots, such as Grenada, Saint Lucia, and Antigua & Barbuda ● PET bottles could be a key focus for the increase of collection and recycling and may require investment in infrastructure, EPR, community awareness campaigns, and identification of end-markets - it would also be useful to collaborate regionally to ensure economies of scale for proper management of PET ● Ministries could include waste management explicitly in any further disaster preparedness, disaster relief, and climate resilience planning in Dominica, and ensure alignment across departments, agencies, and offices within the government ● Identify creative solutions to supplement funding for government-led solid waste management, such as additional zero-waste, circular economy, or sustainability taxes for incoming visitors or tourism operators such as cruise lines - similarly, a portion of the funds that private companies pay for importing goods as part of the Environmental Tax in Dominica could also be allocated towards waste management and circularity initiatives ● DSWMC has collaborated in the past with fishermen on waste management, but it would be beneficial for a more formal relationship or set of messaging to be

	developed around best practices for disposal of fishing gear, particularly nets, traps, oil, empty ice bags, and other problematic items
LEAKAGE 	**Findings:** Litter surveys were conducted across 50 1x1 km^2 land-based transects across the island, 10 coastal and beach locations on the west coast, and along a 20 km stretch of nearshore ocean on the west coast. In addition, 11 1L water samples around the island were surveyed for microplastic concentrations and characterization. The majority of land-based litter (~70%) was plastic. Common items included hard plastic fragments, plastic food wrappers (including small plastic bags from candies and ice pops), plastic bottles, and plastic bottle caps. Slightly lighter litter densities were observed on beach and coastal areas. Open dumping, particularly along the coast and for C&D waste, also presents a key challenge. Interventions should be targeted at preventing land-based litter from entering the ocean via key pathways, such as rivers, canals, and storm drains. **Opportunities:** ● DSWMC could explore collaborations with the Bureau of Standards and local schools to increase litter and microplastic monitoring across Dominica to further research major sources, sinks, and potential health concerns ● Trash intervention mechanisms could be placed along rivers, canals, storm drains, coastlines, and other major land-based sources of marine debris across the island; this could be done in collaboration with DOWASCO ● Conduct further research into the prevalence and potential health impacts of microplastics in key commercial fish species in Dominica ● Engage local tourism operators in documenting and removing litter and debris, particularly from the marine environment (such as dive operators, whale watching trips, and others) ● Work with local school groups, clubs, and businesses to include cleanups as part of regular events, particularly beach cleanups, and continue initiatives such as the annual Clean A Mile and International Coastal Cleanup ● Encourage the use of technology like the Debris Tracker App or others to collect litter data in a standardized format across the island that can be used to track changes over time ● NEP efforts could continue to be funded and supported across the island; where possible, conduct monitoring in those areas to continue demonstrating their positive impact on road cleanliness ● Provide support for enforcement of Litter Act fines, potentially through additional Litter Wardens in rural areas of Dominica

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Glossary of Acronyms and Abbreviations

CAP	Circularity Assessment Protocol
CE	Circular Economy
CIL	Circularity Informatics Lab
CREAD	Climate Resilience Execution Agency for Dominica
C&D	Construction and Demolition Material
DOWASCO	The Dominica Water and Sewerage Company Limited
DSWMC	Dominica Solid Waste Management Corporation
DTDC	Door-to-door Collection
EPS	Expanded Polystyrene
EPR	Extended Producer Responsibility
FMCG	Fast-Moving Consumer Goods
HDPE	High Density Polyethylene
GDP	Gross Domestic Product
INC	Intergovernmental Negotiating Committee [for the UN Global Plastic Treaty]
LAC	Latin America/Caribbean
MLP	Multilayer Plastic
MPs	Microplastics
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NMI	New Materials Institute
OECS	Organization of Eastern Caribbean States
PCR	Post-Consumer Recycled
PE	Polyethylene
PET	Polyethylene Terephthalate
PLA	Polylactic acid
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
rPET	Recycled Polyethylene Terephthalate
SIDS	Small Island Developing States
SUP	Single-Use Plastic
SWM	Solid Waste Management
TPD	Tons Per Day
UGA	University of Georgia

Introduction

The Caribbean Sea and the sovereign states and dependent territories within it have long been known worldwide for their natural beauty. The area is considered a biodiversity hotspot, covering 4 million km2 of sea, 230,000 km2 of land area, and over 7,000 islands, islets, reefs and cays that are home to thousands of endemic species, many of which are threatened or endangered (Figure 1) (CANARI, 2019). As of 2016, the region has a permanent population of 638 million people (Kaza et al., 2018). It is also one of the most frequented tourism hotspots worldwide, attracting over 27 million visitors annually and bringing in $57 billion/year in gross revenues from marine and coastal tourism, an estimated 15% of the region's GDP. Fisheries and ocean-going transportation are estimated to contribute an additional several billion USD (Diez et al., 2019).

Unfortunately, the combination of heavy tourism, coastal development, rising ocean temperatures, increased hurricane activity, and overfishing in the region in recent years has led to a decline in the natural environment of the Caribbean (Weatherdon, 2016; IUCN, 2017; CANARI, 2019). The region is particularly vulnerable to these impacts, especially that of marine pollution, and it is estimated that the cost of inaction to address marine pollution will have a disproportionately high impact on Caribbean nations that are heavily dependent on tourism and fisheries (Lachmann, 2017; Mittempergher et al., 2022; Raes et al., 2022). Some Caribbean countries have estimated annual direct costs of mismanaged waste, including revenue loss from fisheries and clean-up costs alone, of up to $15 million USD/year (Mittemergher et al., 2022). Plastic pollution in particular is a key area of concern for the Caribbean - some reports have found an average of over 2,000 litter items/km in select Caribbean countries compared to a global average of 573 items/km, and up to 80% of marine litter on the coasts and 12% of the waste stream is comprised of plastic (Diez et al., 2019).

Caribbean SIDS have historically faced unique challenges with solid waste management, including lack of waste management infrastructure, lack of capacity and finance to implement and enforce regulations, wide geographic spreads making logistics and economies of scale difficult, and a need for harmonized data collection and monitoring (Busch, 2022). In recent years, Caribbean nations and territories have made major strides towards combating plastic pollution. Over 20 Caribbean countries have currently implemented some form of national plastic policy and several more are in negotiation, including 46 policies and regulations implemented as of 2020. The majority of SIDS have also ratified, signed or acceded to a global and regional instrument, protocol, or convention related to marine debris (Busch, 2022). SIDS have been organizing and playing an active role in the UN Global Plastics Agreement negotiations (IUCN, 2023). Studies have demonstrated that there is a high amount of transportation of marine litter within the Caribbean Sea, further emphasizing the need for collaborative regional action in order to tackle the issue (Courtene-Jones et al., 2021). The CAP

is one of many tools that could support such regional action through shared definitions, methods, data, and nomenclature across geographies.

Figure 1: Sovereign States and Dependent Territories of the Caribbean (GoogleMaps)

Known commonly as “The Nature Isle” or “The Nature Island,” Dominica is home to an abundance of natural beauty and natural resources. Located in the Lesser Antilles in the southern Caribbean, Dominica has a land area of 751 km^2, including nearly 150 km of coastline, and a population of 74,600. The country’s government operates as a parliamentary republic and is politically divided into ten parishes. The economy of Dominica is dependent on agriculture and fisheries but also has strong and emerging sectors in ecotourism, education, and communication (CIA World Factbook, 2023). Some of the key drivers of ecotourism in Dominica are beaches, abundant freshwater pools, scuba diving locations, and a resident population of sperm whales, all of which have the potential to be strongly negatively impacted by plastic pollution.

Following the devastating impacts of hurricanes Maria and Irma in 2017, Dominica invested heavily in resilience and disaster preparedness. In 2018, Dominica passed the Climate Resilience Act, which mandated the Climate Resilience Execution Agency for Dominica (CREAD) and led to the development of the Dominica Climate Resilience and Recovery Plan of 2020. The Plan lists ongoing and planned initiatives in Dominica that are addressing climate resilience, including

a section on Waste and Recycling which outlines objectives to divert waste from landfills, reduce waste generation, decrease littering, and increase public awareness. Specific proposed activities to be completed between 2020-2025 include legislation and incentives to reduce the volume of waste going to landfills, promoting reuse and recycling, construction of a MRF, developing a bulky waste collection system, and running a public awareness campaign (CREAD, 2020). The plan also notes Dominica's existing Single-Use Plastic (SUP) Ban implemented in 2019 - which bans the import of several problematic plastic items such as expanded polystyrene, utensils, plates, and straws (Skerrit, 2018) - and states:

> *"Ban on single use plastics – notably following a disaster, the proliferation of plastic waste, especially when the waste collection system is overwhelmed, causes significant damage to the environment, clogs sewerage systems and small waterways, increasing the risk of flooding in certain areas, as well as damages the marine environment with long-term effects"*

Members of Dominica's Ministry of Environment and the Dominica Solid Waste Management Corporation (DSWMC) have participated in the negotiations for the UN Global Plastics Agreement and want to ensure that Caribbean Small Island Developing States (SIDS) have a strong voice in the final agreement language. Dominica has set the goal of becoming the world's first Climate Resilient nation, and it is clear that the future of solid waste management and of climate resilience in Dominica are intrinsically linked (CREAD, 2020). In 2023, Dominica was named one of two Caribbean countries, along with Grenada, for a pilot by the Organization of Eastern Caribbean States (OECS) called Recycle OECS. The country has made great strides in recent years to move towards a more sustainable future, but leaders there are also open about the need for data to justify interventions, bring in additional funding and capacity, and measure the success of their growing body of work in this space over time.

The Circularity Informatics Lab (CIL) at the University of Georgia (UGA) developed the Circularity Assessment Protocol (CAP) in 2018, which is a standardized assessment protocol used to collect community-level data to inform decision-makers (Figure 2). The CAP characterizes seven community components:

1. **Inputs** – What products are sold in the community and where do they originate?
2. **Community** - What conversations are happening and what are the stakeholders' attitudes and perceptions?
3. **Product design** - What materials, formats, and innovations are found in products, particularly packaging?
4. **Use** – What are the community trends around use and reuse of product types?
5. **Collection** – How much and what types of waste are generated? How much is collected and what infrastructure exists?

6. **End-of-cycle** – How is waste disposed? What is the fate of waste once it is properly discarded? How is it treated?
7. **Leakage** - What waste ends up in the environment? How and why is it getting there?

In addition to the standard seven spokes of the CAP fieldwork, two additional components were investigated to better understand ties between land-based and marine litter in and around Dominica and to better characterize the extent to which marine debris poses a threat to the natural environment and marine life of Dominica:

8. **Environment** - What is the status of plastic pollution in the coastal habitats and offshore of the study area? What are the most harmful/prevalent litter items and where are they likely coming from?
9. **Impacts** - Are there correlations between the types of polymers (>50-micron samples) that end up on the land/coast as litter and those found on reefs and in the surrounding water? What are some of the documents and/or anticipated impacts on the coastal environment, particularly on the sperm whale population?

Figure 2: Circularity Assessment Protocol (CAP) hub-and-spoke model

The CAP in Dominica serves as a holistic approach to characterize the state of plastic pollution and marine debris on the island and to inform the most effective upstream solutions to stop it at the source. CAP fieldwork was conducted in Dominica in April and October 2023 with guidance from the Dominica Solid Waste Management Corporation (DSWMC), funding from Dynamic Planet, and volunteer support from the Dominica State College. The CAP report is split into the following sections, which include results and discussion of each: Input, Community, Product

Design, Use, Collection, End of Cycle, and Leakage, followed by Opportunities. Given its size, the Dominica CAP encompasses the whole island with a focus on the leeward side of the island (Caribbean side) where there are local populations of sperm whales, vessel traffic, and the capital city.

With the current national momentum to address sustainability, resilience, and conservation in Dominica, there is a clear opportunity for positive action toward litter prevention and circular materials management. A critical first step in that process is to understand the existing context in terms of sources, sinks, and pathways. CAP data can be used by local partners in Dominica to prioritize interventions, justify key proposals, inform local campaigns and messaging, engage the private sector and identify potential new jobs, and ultimately put knowledge in the hands of decision-makers. The CAP methods are conducted in collaboration with local partners to build capacity for harmonized evaluation and monitoring across departments and organizations on-island. This work also has the potential to position Dominica as a model for other islands in the Lesser Antilles and broader Caribbean that are also interested in increasing their circularity. This is the first time that a study like this has been completed in Dominica and will be critical for the local community and region. With support and leadership across Dominica's Solid Waste Management Corporation, government, businesses, and citizens, and with funding and additional support from Dynamic Planet, the 'Nature Island', will be healthy, clean, and resilient for local residents and visitors alike for generations to come.

Sampling Strategy

In order to randomly sample various locations in a city, the CAP typically identifies a 10 x 10 km area over the city of interest (Maddalene et al., 2023; Jambeck et al., 2024). In the case of Dominica, the aim was to randomly sample across the entire island and country. As such, ambient population was examined across the whole country using LandScan 2021 data from Oak Ridge Laboratory. As the majority of population density in Dominica is concentrated within 2km of the coastline, a perimeter of 2 km inland from the coastline was cast across the island. Within this area, the ambient population was sectioned into tertiles (three groups) (Figure 3). Ambient population count can be described as "where people go" and "societal activity" and is measured by the quantity of people that pass through a given area over a 24-hour period — it is not population density of where people live. These three areas typically form samples of different land uses and activities. To further specify the sample area, five 10x10 km square areas and two 1x1 km square areas were identified collaboratively with DSWMC and Dynamic Planet that provided representative areas of development and societal activity across the island (outlined in red in Figure 3).

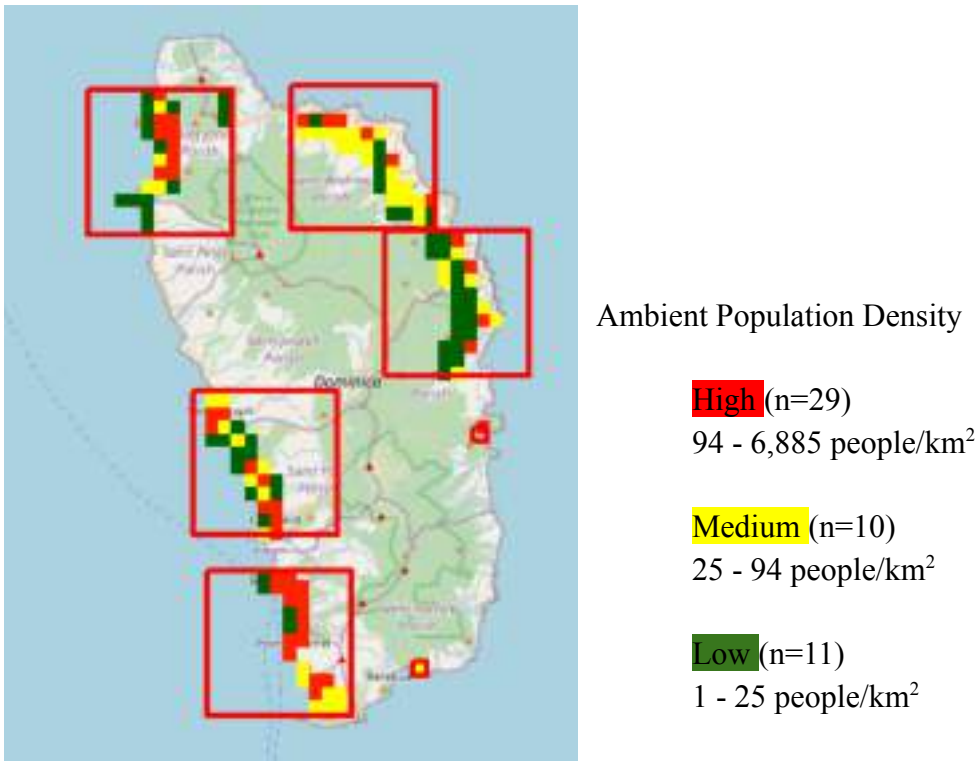

Figure 3: Population tertiles identified within potential sampling area in Dominica

Within each larger 10x10km sampling area, three 1 x 1 km areas for surveying were randomly selected (one within each population tertile) using NOAA's Sampling Design Tool (Figure 4). Additional 1 x 1 km areas were selected within the smaller sampling areas near Rosalie and Stowe. In total, 17 1 km^2 sites were surveyed for store product samples and restaurant product samples. Within each 1 x 1 km square, three 200 x 200 m squares were also randomly selected using NOAA's Sampling Design Tool to conduct 100 m litter surveys. Some locations had to be adapted in situ to accommodate for accessibility and safety and best efforts were made to sample areas immediately adjacent or similar in setting to those identified in GIS. This resulted in 50 litter transects across the island.

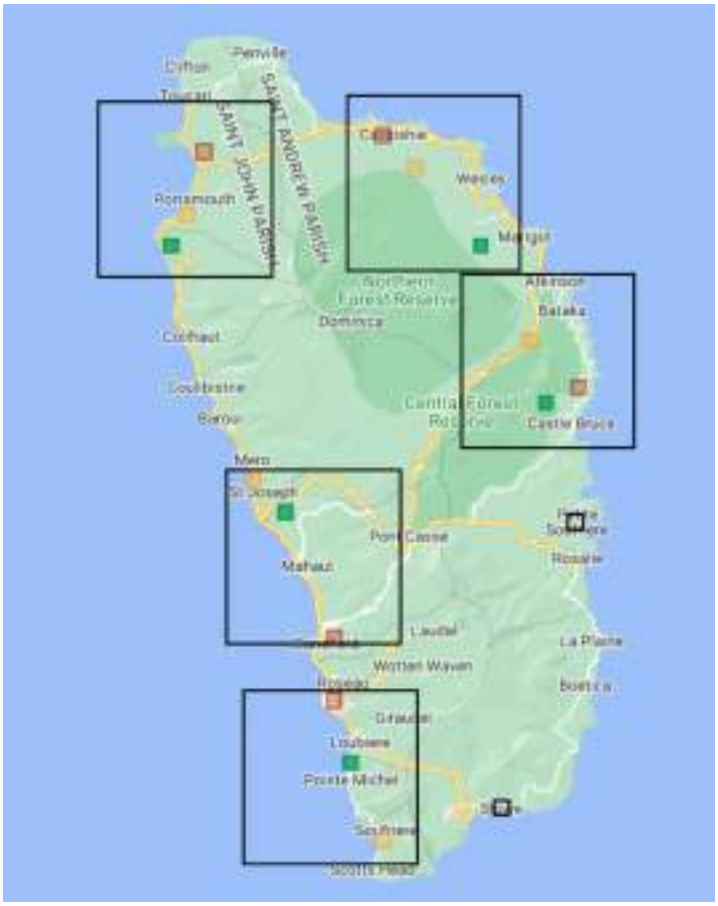

Figure 4: Final CAP Sampling Sites identified through GIS in Dominica

In addition to the standard CAP methodology, litter surveys were also conducted at 10 randomly selected coastal and beach areas and a 20 km stretch just offshore along the west coast of the island. Microplastic analysis was also conducted from existing filtered water samples from offshore locations collected by the National Geographic Pristine Seas team around Dominica in December 2022 (NGS, 2024). This holistic data will allow connections to be made between land-based and ocean-based sources of pollution in Dominica and can most effectively inform methods for prevention.

Input

To get a snapshot of the characterization, scope, and source of common plastic packaged items that are entering Dominica, samples of fast-moving consumer goods (FMCG) in five popular categories were taken within the 17 1 km^2 transects across the country. The sampling team selected three convenience or grocery shops to sample within each $1km^2$ transect area, where shops were present and open at the time of surveying. In total, 225 unique brands of convenience products were collected and sampled, including 110 candies, 24 chips, 54 beverages, 22 tobacco

products, and 15 biscuits/wafers (Figure 5). Samples of identical brands were not collected multiple times, even when present in multiple stores. Common brands of tobacco products were also visually assessed in stores, although samples were not purchased.

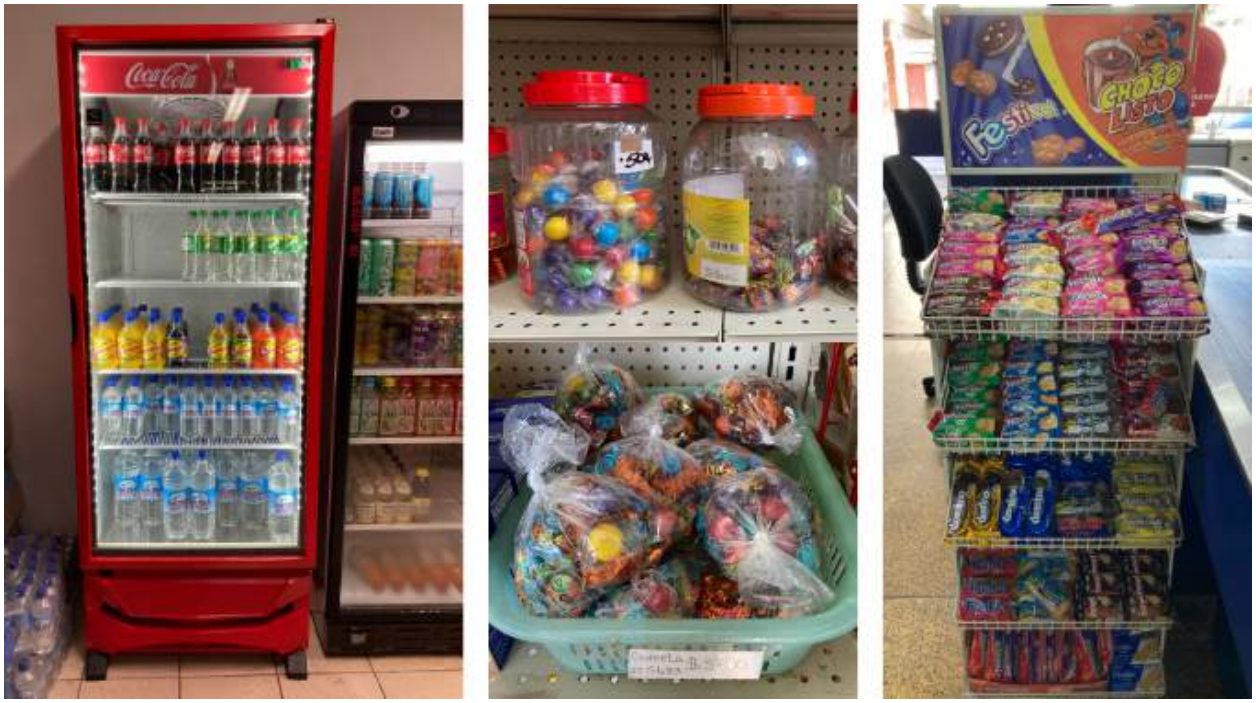

Figure 5: Typical convenience store packaging in Dominica

For each of the top products documented, the team noted the type of packaging (including polymer, if possible), the brand, and the parent company. From there, the team was able to determine the manufacturing location, which was determined from manufacturing locations listed on product packaging or desktop research, as well as the headquarters location for the parent company of the brand (largely determined by desktop research). Manufacturer and parent company distances (Table 1) are intended to estimate the distance in kilometers between the city and the origin of each product.

Table 1: Distances between Dominica and manufacturer and parent company locations for top FMCG convenience items

	Length Store to Parent Company (km)				Length Store to Manufacturer (km)			
	Min	Max	Median	Avg	Min	Max	Median	Avg
Beverages	1	14,087	1,679	2,790	1	2,1950	664	2,641
Biscuits & Wafers	310	8,980	515	2,222	0	9,892	632	2.571

Candy	0	15,694	3,140	4,076	0	23,855	3,779	5,363
Chips	0	4,087	1,099	1,839	0	9,213	1,675	2,668
Tobacco Products	0	13,936	3,285	4,536	0	7,687	3,460	3,152

*Note: Distances were projected using an Azimuthal Equidistant projection. Values have been rounded to the nearest km.

Top brands of each category, based on a visual assessment of shelf space in a store, conversations with shopkeepers, and repeated occurrence across stores, included the following:

- **Beverages**: Coca-Cola, Busta, Quenchi, Trois Pitons
- **Biscuits/Wafers**: Shirley, Domino, Tea Time, Bermudez
- **Candy**: Mints & Ginger Mints (Fitzroy & Pereira), M&M, Cadbury, Xtime
- **Chips**: Holiday, Cutters, Bermudez, Lays
- **Tobacco Products**: Dunhill, Hillsborough, Special, Marlboro

Among all of the five FMCG categories, each had at least one example of a manufacturer that was located domestically in Dominica, and all categories except for Biscuits/Wafers had at least one parent company located in Dominica (Table 2, Figure 6, Figure 7). On average, candy products and tobacco products had manufacturing and parent companies located farthest from Dominica.

Table 2: Top Manufacturing/Import Locations for top FMCGs in Dominica

FMCG Category	Top Three Manufacturing/Import Locations
Beverages	1. Trinidad & Tobago (30%) 2. United States (17%) 3. Dominica (9%)
Biscuits & Wafers	1. Trinidad & Tobago (53%) 2. Colombia (13%) 3. Turkey (13%)
Candy	1. United States (47%) 2. Trinidad & Tobago (14%) 3. China (7%)
Chips	1. United States (33%) 2. Jamaica (33%)

	3. Trinidad & Tobago and Dominica both had 12.5%
Tobacco Products	1. United States (33%) 2. Dominica (33%) 3. Peru and UK both had 17%

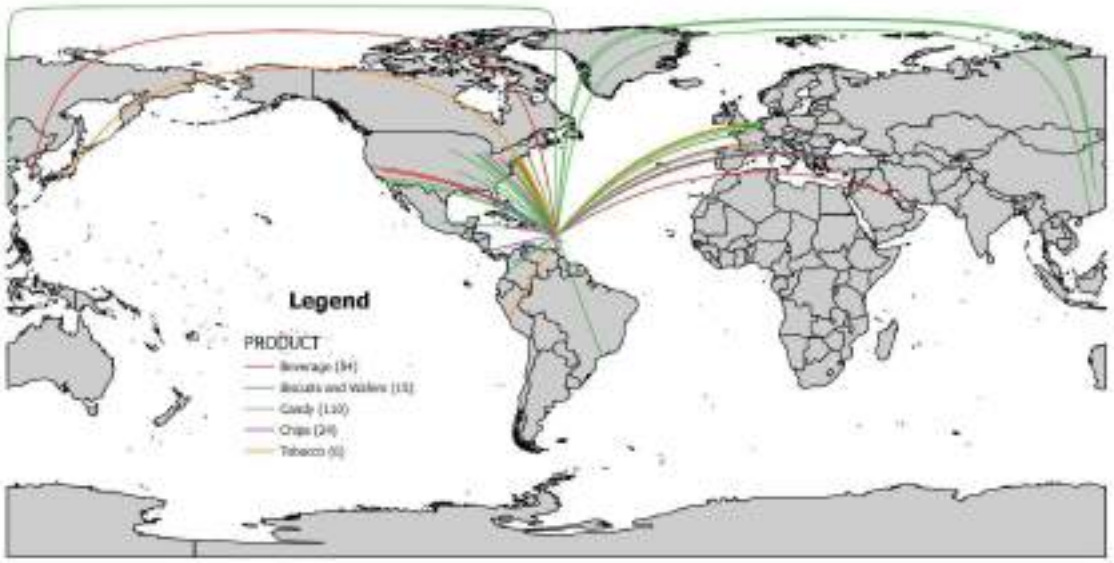

Figure 6: World Map displaying parent company locations for top convenience items in Dominica

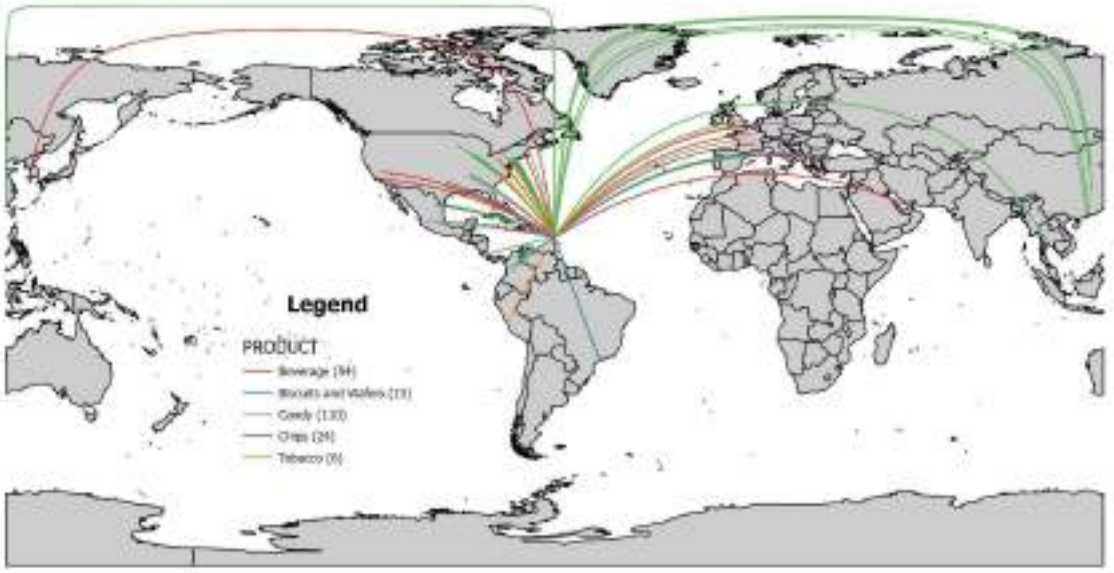

Figure 7: World Map displaying manufacturing locations for top convenience items in Dominica

All categories had large amounts of products imported from other Caribbean countries, mainly Trinidad & Tobago and Jamaica, as well as from the United States (US). Trinidad & Tobago was among the top three importing locations for all FMCG categories except for Tobacco Products and the US was among the top three importing locations for all FMCG categories except for Biscuits/Wafers (Figure 8).

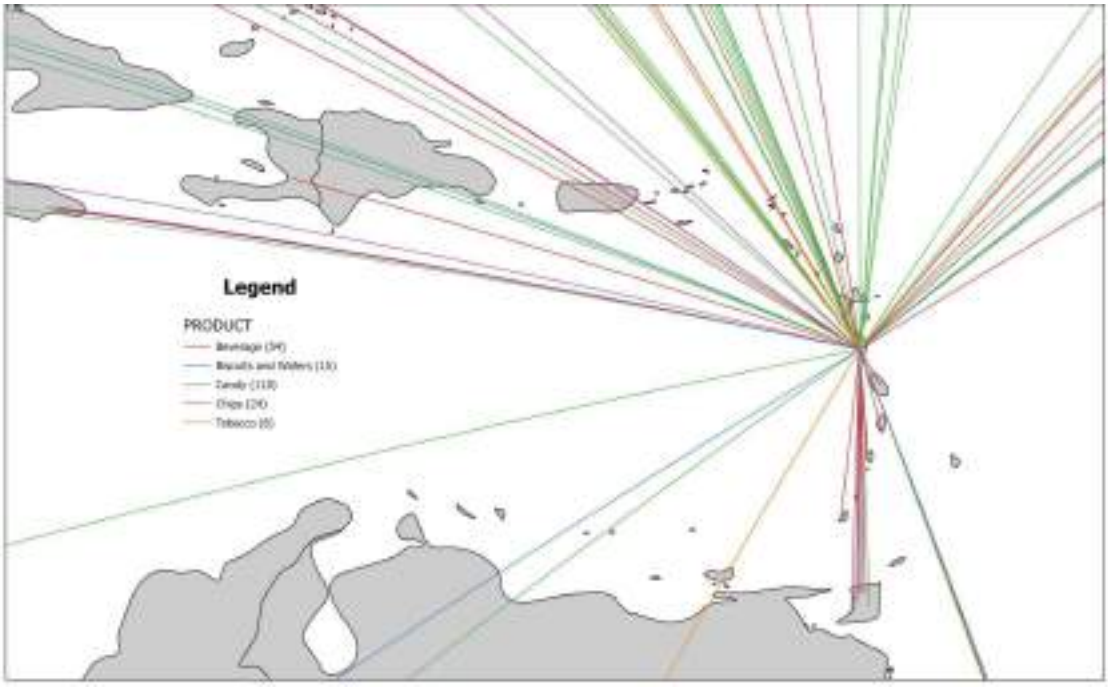

Figure 8: Zoom in on map of the Caribbean displaying manufacturing locations for top convenience items in Dominica

Across all FMCG categories, 94% of products are manufactured outside of and imported into Dominica (Figure 9). Similar quantities were found among parent companies of convenience products (Figure 10). Compared to other island nations, a recent CAP in Aruba found over 99% of FMCGs originated internationally and a CAP in the Maldives found 95% of FMCGs originated internationally (CIL, December 2024; CIL, October 2024). While Dominica is still among the top three locations for both manufacturers and parent companies of FMCGs overall, there are ample opportunities for increasing domestic operations for common consumer products, as well as for enhancing buy-back and extended producer responsibility (EPR) schemes. Particularly for beverages, there could be opportunities to also explore overlaps with health initiatives related to sugar-sweetened beverages that are imported internationally. The Latin America/Caribbean region is among the top consumers of such beverages, and using tools such as import taxes, marketing, and labeling could potentially help with human health as well as pollution reduction (Lara-Castor et al., 2023). One local company in Dominica reportedly pays 3% on all imported goods as part of the local Environmental Tax, but it is unclear what the final use of those funds is and whether there are options for those funds to go towards waste management circularity initiatives.

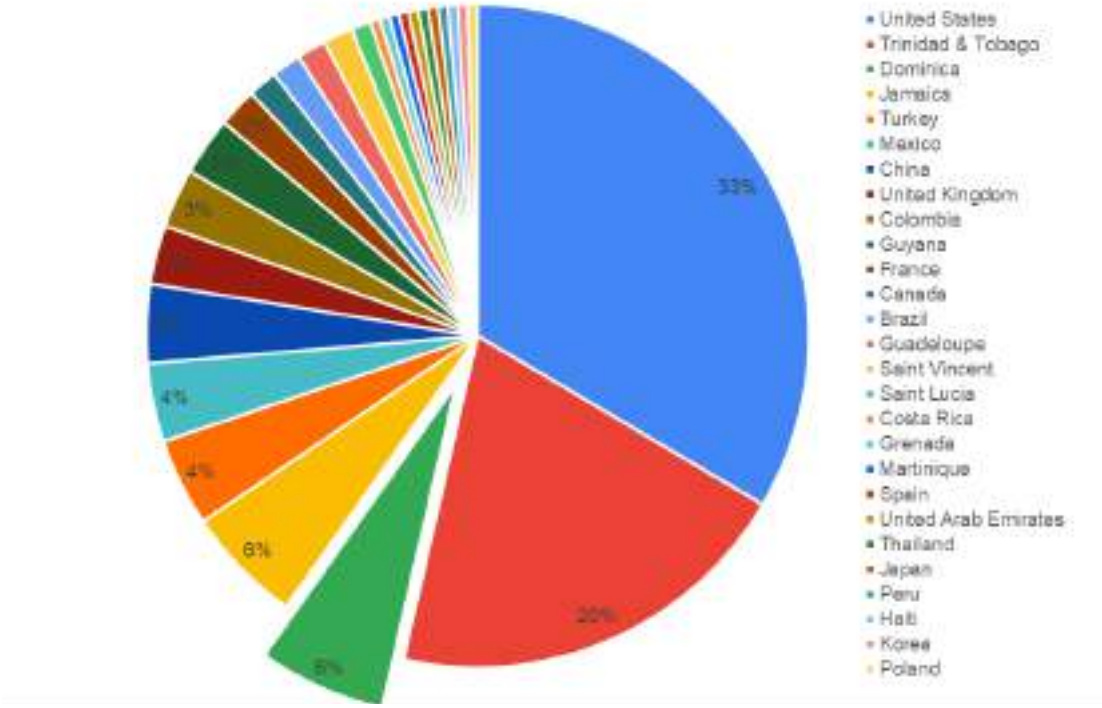

Figure 9: Manufacturing Locations for Commonly Found Convenience Items in Dominica

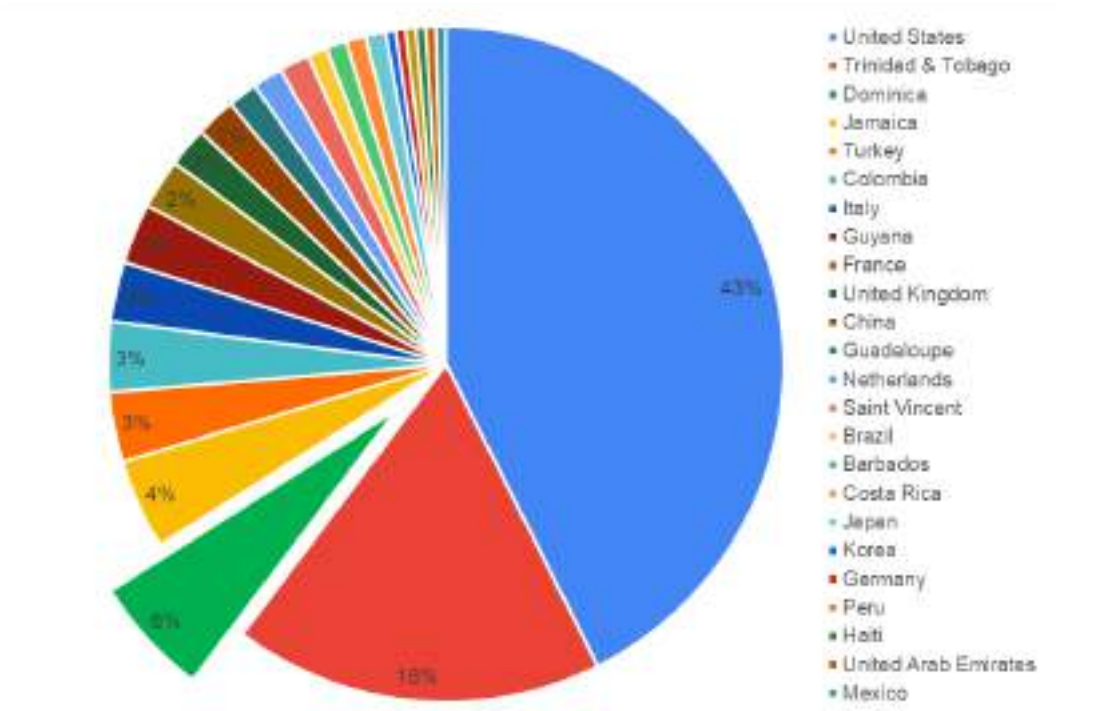

Figure 10: Parent Company Locations for Commonly Found Convenience Items in Dominica

It is also important to note that among the beverages surveyed, 10 bottled water brands (all of which were bottled in clear PET) were manufactured outside Dominica and imported to the island. It would be worth exploring opportunities to bottle local fresh water or increase production from local operations such as Trois Pitons, as opposed to importing bottled water from other parts of the Caribbean. There was reportedly another bottling operation on the island that produced and distributed local spring water, but it was destroyed in Hurricane Maria and has not been rebuilt, in part due to the lack of buildable land and access to water that has not been contaminated by agriculture - though it is worth noting that the government is encouraging shifts to local organic fertilizer and upgrading pesticide legislation. Trois Pitons bottles are filled locally with purified municipal water. Currently, Josephine Gabriel & Co. distributes Coca-Cola beverages, Trois Piton water, and Quenchi beverages in Dominica in various sizes. The Coca-Cola beverage and PET bottles are imported together from Saint Lucia while the Trois Piton and Quenchi products are bottled at the plant in Canefield using PET bottles imported from Barbados. All of these products were traditionally bottled in glass, but they switched to PET in 2010 because of the high cost of the glass supply chains, coming largely from Costa Rica and Mexico. Josephine Gabriel & Co. have conducted temporary promotions related to extended producer responsibility in the past, such as encouraging consumers to bring back their bottle caps for prizes. This had not been tried with the PET bottles due to contamination concerns. However, consumers increasingly want to win prizes on their phones or via social media instead of physically bringing in items, and the promotions have not happened for a while. Josephine Gabriel & Co. wants to support and invest in recycling infrastructure for PET in Dominica, but this will likely require investment from Coca-Cola. They are also working with a recycling broker to identify local markets, as Coca-Cola's 'every bottle back' campaign does not include Dominica. Coca-Cola is reportedly working on developing biodegradable bottles, which the subsidiary is also interested in.

> *"In an ideal world, whatever we produce can be properly collected, sorted, recycled, and then sent back out into the community." - Private Company*

In addition to domestic opportunities, the Input data also reveals a strong FMCG market within the Caribbean. Top importing Caribbean Island nations include Trinidad & Tobago, Jamaica, Guadeloupe, Saint Vincent, Grenada, and Martinique. Other key importers within Latin America include Colombia, Guyana, Peru, Costa Rica, and Mexico. A small amount of Trois Pitons and Quenchi bottles are exported from Dominica to other Caribbean islands, including Guadeloupe, Martinique, Sint Maarten, and the British Virgin Islands. These countries should be prioritized for collaborations around regional-level EPR schemes to minimize waste and enhance local economies.

Community

To understand current attitudes and perceptions of plastic waste, semi-structured interviews were conducted with 28 key stakeholders. Among those interviewed, 11 were government officials, 6 were students from the local university, 3 were from private companies (including tourism operators), 2 were community leaders, 2 were from non-profit organizations, 2 were private store owners, and 2 were private restaurant owners (Table 3). In addition, a social media analysis was conducted for plastic pollution in the Caribbean in collaboration with SEE Suite (Social Media Engagement & Evaluation Suite) at the Department of Advertising and Public Relations at the University of Georgia, which is described in Section 4.4.2.

Table 3: Summary of Stakeholder Interview List

Stakeholder Group	Number of Interviews
Local Government	11
Students	6
Private Companies	3
Community Leaders	2
Non-profit Organizations (NGOs)	2
Store Owners	2
Restaurant Owners	2

Community: Stakeholder Interviews

While studies have noted that the human dimension of plastic pollution in SIDS has been historically understudied, those studies have also found that, when the topic is investigated, there is general awareness of the issue, concern around associated environmental and human health, willingness to participate in solutions (such as waste separation), and multiple entry points for different types of policies to affect society (Raes et al., 2022; Kanhai et al., 2024). The need for increased and consistent public engagement, education, awareness, and buy-in for SUP alternatives in Dominica was a common theme across interviews (examples in Figure 11). When it comes to waste sorting, using alternative materials, or bringing your own reusable items,

messaging in Dominica needs to be relevant and consistent. Several interviewees noted the value of engaging Dominicans at specific venues where they are already present and engaged, such as entertainment events, cultural festivals, church gatherings, youth clubs, workplaces, and grocery stores, as opposed to creating new spaces or tools for communicating. Interviewees also mentioned the importance of using platforms that Dominicans already engage with, such as radio and social media, to reach people with key messaging and embed that messaging in popular content. The challenge, as was mentioned several times, is moving from communication and messaging to engagement and consumer action.

> *"There's a difference between informing people and engaging people - the challenge always lies in actually getting people to take action, shop with a reusable bag, get engaged" - NGO*

The importance of making changes affordable and convenient was also heavily emphasized in stakeholder interviews. When it comes to reuse, several interviewees cited concerns around hygiene and convenience generally, which should be targeted for messaging if reuse initiatives are implemented in Dominica to assuage and address community skepticism. Messaging and incentives need to be able to reach all consumers, not only those who care strongly about the environment or nature.

> *"Some people are very willing to pay 50 cents for a bag instead of purchasing a reusable one for 5 dollars - you need to make it easy for people to make those changes." - NGO*

Figure 11: Examples of education and outreach posters from DSWMC

Incentives were often touted as a success when it comes to waste collection and recycling for specific items in Dominica. Specifically, some local breweries will provide money off for beer

purchasing if consumers bring back their original glass bottles. Interviewees emphasized that Dominicans need to see an incentive for separating out their waste and for reusing, returning, and recycling certain items and that those incentives need to be effectively enforced.

> *"People respond to incentives. If you can incentivize a project it's going to be successful…We collect more beer bottles than we sell, and our margins on drinks are so minimal, it offsets our purchasing. Incentivizing recyclables works." - Private Business*

Some interviewees also felt that there may be opportunities for effective science communication, particularly around the ties between plastics and human health, in order to make topics relevant to individual people and families. They also felt this would be useful to demonstrate that certain habits can have a negative impact on both their wallet and their health. Dominica's identification and reputation as the "Nature Island " also came up often in interviews, and several interviewees suggested that national messaging around waste and pollution should be centered around the pride of place that comes with that designation. Some mentioned that Dominica wants to be set apart from other SIDS that are often portrayed as 'dumping grounds' and they want to ensure that there is a circular process for everything that enters the island.

> *"The good news is that people here take pride in being the 'nature island.' People are proud of the national trail. This [Dominica] is the hidden gem. It's not a stretch to tie it [pollution prevention] into that national pride of the environment here." - Private Business*

> *"People need to understand the meaning of the Nature Island. They know the mountains, the rivers, the sea, but they don't take action to properly take care of it." - Local Government*

However, some also highlighted the challenges of tying nature and the environment to topics of waste and pollution. Some government officials cited concerns around the triple planetary threat of climate change, biodiversity loss, and pollution - which is evident through Dominica's efforts to become a climate-resilient island - but it was noted that leaders don't readily make the connection that waste management is a key tool for addressing pollution and that those aspects are all linked.

> *"As a region, we tend to focus more on the environment, and we don't look at solid waste." - Local Government*

Interviewees also had varying responses to the single-use plastic ban in Dominica. Local manufacturers and distributors in particular had a difficult time with implementation, as they have traditionally relied heavily on plastic packaging and had difficulty affording the often more

expensive alternatives. Some mentioned that they felt disenfranchised because supermarkets were still able to import products that were packaged in the same plastic material that they couldn't import for manufacturing (e.g., individually wrapped biscuits). Government officials mentioned that they had to allow extra time for businesses to find and afford suitable alternatives, particularly to EPS products that had to be lightweight and waterproof. A great deal of public education and outreach was conducted in advance of the implementation of the ban, including handing out 60,000 reusable bags to the public, hosting local pop-up stands at grocery stores, working with local supermarkets and restaurants to offer discounts for customers that brought their own reusable items on certain days, and others. DSWMC also held a community consultation after the ban went into effect and realized that businesses were still struggling with affording alternatives, and the government ended up temporarily removing the import tax on plastic alternatives such as paper products. For consumers, confusion still remains around conventional vs. biodegradable vs. compostable plastics. Often the products that are now able to be imported cannot biodegrade properly in the environment, require industrial composting, or are mislabeled traditional fossil-based plastics. Enforcement is an ongoing challenge, particularly around litter tickets that are handed out under the Litter Act of 1990.

> *"[Our agency] has been trying to message to the public that "litter is litter" so that people don't think it's alright to leave certain trash items in the environment." - Local Government*

> *"Enforcement is an area I'd like to see us improve on. Litter tickets are not well respected. There is a reluctance to prosecute or fine people, which could be revenue for the government." - Local Government*

Another social and administrative challenge is the topic of implementing waste separation for the public in Dominica. This has been a key topic for DSWMC in recent months. A key question is how to incentivize separating household waste at the source, whether that should take place through upfront charges, penalties for incorrect separation, or otherwise. Similarly, the issue of open dumping is an ongoing challenge. As is common in other island contexts and in locations with active rivers and streams, the hydrology of Dominica often lends itself to a method of waste management in and of itself, whereby the waste that is accumulated in storm drains, along rivers, on beaches, and elsewhere is flushed into the ocean with heavy rainfall. This also remains a challenge for Public Works and for The Dominica Water and Sewerage Company Limited (DOWASCO).

> *"It [litter and waste] stays there [in the environment] until the next big storm, then it is washed out." - Private Company*

> *"A few weeks ago, I was hiking segment 9, where you have to cross 11 tributaries. I saw lots of litter where people are stopping to cross upstream … At [storm drain] intakes, sometimes we will find plastic bottles that are 25 years old, from brands that are not sold here anymore. They could have been higher up on the mountain and for a long time and got washed down." - Local Government*

> *"'The sea will swallow everything,' that is still the stigma, especially in country [rural] areas. People dump trash at rivers or burn it even if they know better … It comes down to convenience." - Local Government*

The value of regional collaboration was cited as a key opportunity for exchanging lessons learned on outreach, messaging, waste management techniques, and capacity sharing. A WhatsApp group exists for waste managers across islands in the Caribbean and OECS where they can regularly connect, share ideas, and problem-solve. There has been interest from DSWMC in formalizing that group via in-person meetings, digital platforms, and otherwise to ensure that waste management capacities are shared and maximized across the region. For example, one interviewee noted that Saint Lucia is working on a RePlast program to repurpose their plastic waste, and Saint Vincent has developed a private network of recyclers that is subsidized by the local government. Dominica has been playing an active role in the UN Global Plastics Agreement negotiations and there are also opportunities for knowledge sharing, collaborative advocacy, and potentially for Dominica to become a model not only for a climate-resilient island but also a fully circular one.

Community: Social Media Analysis

In order to gain perspectives from a broader group, CIL also conducted an analysis of conversations about plastic pollution in the Caribbean occurring on social media platforms in partnership with SEE Suite (Social media Engagement & Evaluation Suite) at the Department of Advertising and Public Relations at the University of Georgia. The data collection period was January 2022 through August 2023. SEE Suite analyzed content from Twitter, Facebook, and Instagram over that time period.

On Twitter, over 800K mentions related to plastic pollution in the Caribbean were observed for the time period. The majority (75%) had a neutral sentiment. A negative sentiment was observed in 19% of posts, largely related to impacts on the environment and on marine animals, and 6% had a positive sentiment, largely related to actions that companies were taking, bans on SUP, bottle deposits and recycling opportunities, individual actions, and an appreciation for litter-free natural environments. Dominica's focused efforts to reduce plastic production and usage were demonstrated through 5,292 posts (0.65% of the total dataset). Content includes highlights on the issue of plastic pollution within the Caribbean but also demonstrates the diverse efforts and

discussions shaping the region's response. Spikes in Twitter activity on this topic were observed around launches of key campaigns like #LetTheEarthBreathe in April 2022, Earth Day in late April 2022, viral videos and content from regular users around littering and environmental impacts (e.g., Jan 2023), meetings related to the UN Global Plastic Agreement (e.g., May 2023), and World Environment Day in June 2023. Among Twitter mentions on the topic, 8 major themes were found associated:

1. **Tourism:** Tourists' environmental consciousness in the Caribbean is rising. Noteworthy efforts include @WetTribe's Mangrove installations combating Ocean Acidification, supported by retweets from influencers like @Petchary. Major organizations, including IUCN and UN Jamaica, amplify awareness through retweets. Trinidad and Tobago's CESaRE NGO contributes significantly, addressing plastic's impact on the Caribbean environment.
2. **Ocean Cleanup:** #BeatPlasticPollution drives neutral sentiment, focusing on preventing plastics from becoming historical relics. @USAToday highlights 'The Ocean Clean Up', removing 77 tonnes of ocean trash. @CarbonCredit's innovation in using ocean plastics for car tires gains substantial attention, reflecting a shift toward sustainable practices.
3. **Individual Action:** Individuals are pivotal in the fight against plastic pollution. @jamentrust's widely retweeted post outlines actionable steps. Conversations revolve around proper plastic disposal methods and home-based reduction strategies. Jamaica's EcoKids Project emphasizes children's education, emphasizing their crucial role in this environmental process.
4. **Wildlife:** Global movements like #PlasticFreeJuly gain momentum, aiming to protect marine life. @SuzieBird4's tweet, showcasing plastic harm to Caribbean seabirds, echoes concerns. Discussions emphasize plastics' detrimental impact on both oceans and the wildlife dependent on them.
5. **Waste Management:** Proper waste management is imperative, focusing on negative impacts: Health, Sea, and Human. @JamaicaGleaner sheds light on the struggle of developing nations like Jamaica, particularly in recycling solid waste. @Rainmaker1973 highlights successful waste management projects, preventing significant trash from entering the Caribbean Sea.
6. **Fossil Fuel:** Neutral posts comparing plastic and fossil fuel usage resonate in Caribbean islands. These discussions emphasize the interconnection, stressing the need for fossil fuels in plastic production. Individuals in islands like Puerto Rico, Jamaica, and the Dominican Republic actively engage in these conversations.
7. **Single-Use Plastics:** Conversations starkly outline single-use plastics' ocean impact. Both private users and influential entities like @UN stress the crucial necessity of keeping single-use plastics out of the ocean, reflecting a collective call to action.
8. **Microplastics:** User @voserahlaura's impactful tweet, advocating against littering, gains significant traction in the Caribbean. It resonates widely, urging others neutrally to follow

suit. Additionally, numerous tweets highlight the pervasive presence of microplastics in our environment, underscoring their impact on both humans and the planet.

Top influencers for the topic in Dominica on Twitter included Dominica CBIU (@SominicaCBIU), Zaimis Olmos (@zaimis), and Invest Dominica (@Invest_Dominica) (Figure 12).

Figure 12: Example Twitter post from Zaimis Olmos on a cleanup in Dominica

On Facebook, 5,537 relevant posts were identified during the timeframe with a reach of over 24 million people (Figure 13). Similar distributions were observed for the sentiment analysis, with around ¾ neutral. For posts related to Dominica specifically, comprising 6.8% of the total dataset from Facebook, positive discussions focused on litter collection, clean beach initiatives, and waste disposal management efforts, while negative mentions include efforts to reduce waste during national emergencies, and neutral sentiments related to cultural and personal aspects of Dominica. Similar themes were observed within the Facebook posts.

1. **Overall Conversations:** Much of the content centers around environmental reports, especially from organizations like Jamaica Gleaner. Informational content includes news reports, petitions, and efforts by organizations like NEPA and 242 News Bahamas in cleanup initiatives.
2. **Tourism:** Posts cover a range of Caribbean vacations, primarily advertised by American Holidays and Cayman Airways. There is discussion about the impact of climate change on vacationing, as well as advocacy for Earth Day cleanups by the Minister of Tourism in the Cayman Islands.

3. **Waste Management:** Positive sentiment revolves around congratulating successful waste management initiatives by organizations like The Copper Foundation and the IDB of Trinidad and Tobago. Negative sentiment arises from reports like Plastic News on a methane explosion in the Dominican Republic and discussions about large corporations contributing to pollution.
4. **Large Corporations:** Neutral posts discuss the role of big corporations in plastic pollution, while positive posts highlight instances of beneficial corporate social responsibility. Negative sentiment focuses on blaming big businesses for widespread plastic pollution.
5. **Individual Action:** Neutral posts stress the importance of individual actions in preventing plastic pollution. Positive posts celebrate cleanup efforts and innovative pollution prevention methods, while negative posts highlight the detrimental effects of pollution.
6. **Single-Use Plastics and Microplastics:** Neutral sentiment discusses efforts to reduce single-use plastic, while negative posts emphasize the adverse effects of plastic pollution. Positive posts celebrate progress in plastic-free initiatives.

Figure 13: Examples of Facebook posts related to Dominica that had positive sentiments and high amounts of likes, comments, and total reach

Spikes in Facebook conversation on the topic were related to events such as Earth Day and local cultural festivals, local news stories related to the impacts of plastic pollution in the marine environment, and actions related to key social media campaigns such as #plasticpollutes,

#beatplasticpollution, and #breakfreefromplastic (Figure 14). Key Facebook influencers identified included DSWMC, Plastic Pollution Coalition, Global Alliance for Incinerator Alternatives, Plastic Free Cayman, Jamaica Gleaner, and the Jamaica Observer.

Figure 14: Example spike analysis from Facebook on plastic pollution in the Caribbean, December 2022 - September 2023

Key posts and events also demonstrated spikes in related content and activity on Facebook in Dominica specifically (Figure 15).

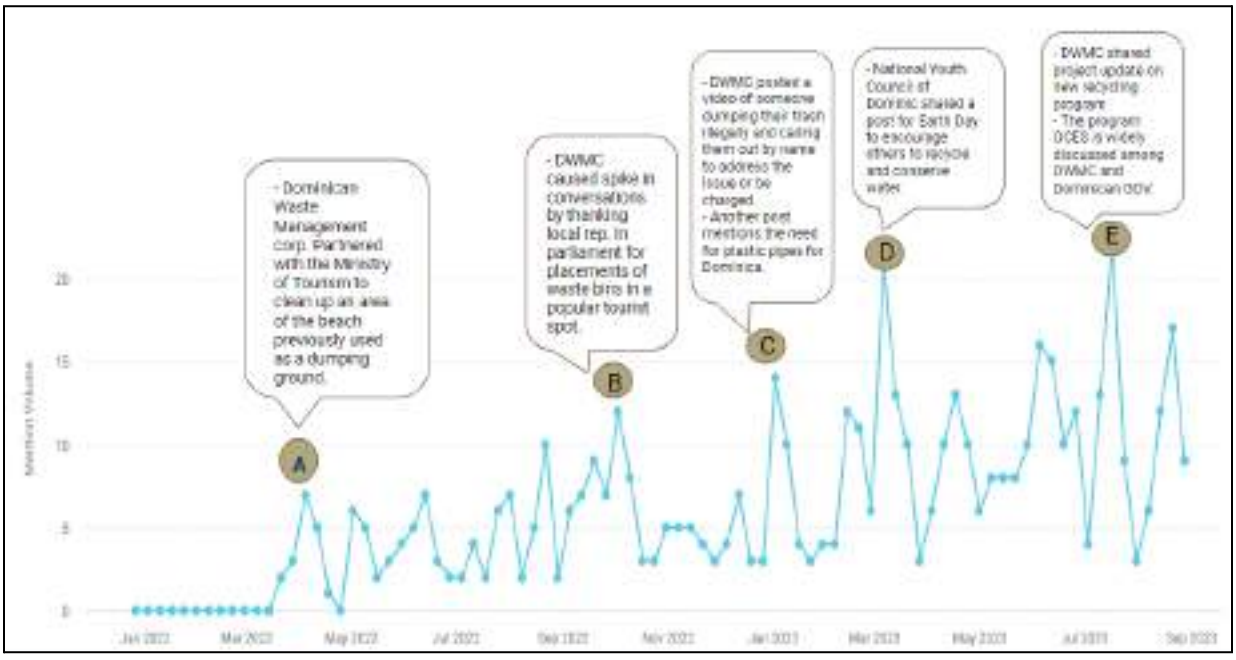

Figure 15: Example spike analysis from Facebook in Dominica specifically

On Instagram, 15.57K relevant results were found with a reach of over 26.3M viewers within the timeframe. Similar themes were observed as those associated with the Twitter and Facebook posts, particularly around tourism, wildlife, and waste management. Top influencing accounts

among global organizations posting about plastic pollution in the Caribbean included @4ocean, @parley.tv, and @plasticpollutes. Much of the conversation on Dominica on Instagram, around 3.5% of the total dataset, was related to tourism in the area. There was also a large portion of the conversation that covered the sperm whale species in the area that is adversely affected by pollution. Some of the other points of conversation were related to efforts that Dominica is making to improve their sustainability, such as the OECS recycling initiative. One particular post by photographer Paul Nicklen that emphasized the importance of protecting wildlife in Dominica had a 770K total reach, 38K likes, and 297 comments (Figure 16).

Figure 16: Post by Paul Nicklen using #Dominica featuring local sperm whales and plastic pollution

There are ample opportunities to engage the public and targeted audiences on plastic pollution prevention and waste management through social media, particularly through platforms and accounts that are already popular in Dominica and the Caribbean. Notably, most of the conversations about plastic pollution in the Caribbean are occurring outside of the Caribbean instead of within the region, presenting an opportunity for local voices to become more engaged in shaping the messaging and perspectives both within the region and worldwide. Dominica could be a key leader in this space and should capitalize on key moments, such as progress with the UN Global Plastics Agreement and local cultural festivals, to highlight positive efforts happening on-island via social media.

Product Design

The purpose of the Product Design section is to characterize the materials and formats found in products, particularly packaging. Data was collected among three types of stores across Dominica: convenience stores (including gas stations, roadside stands, and standard convenience stores that do not sell fresh food), restaurants and food vendors, and large grocery stores.

Product Design: Convenience Products

To characterize material types used in common consumer products, samples of common convenience items were obtained as described in the Input section. The CIL team sampled convenience stores in each of the 1km^2 transects areas. In total, 225 unique forms and brands were purchased to obtain packaging weights. The average weight of both the packaging and the product itself was collected for all samples (Table 4).

Table 4: Average weight of products and their plastic packaging for common convenience items

Product Type	Number of Samples	Average Weight of Plastic Packaging (g)	Average Quantity of Product (g or mL)
Beverage	54	23	448
Biscuits/Wafers	15	1	38
Candy	110	4	31
Chips	24	4	42

Cigarettes were excluded from purchasing of samples in this case, but they are typically a standard size and we have previously found an average of about 10 g of plastic packaging to about 15 g of product. This relatively high plastic packaging-to-product ratio means cigarettes generate larger amounts of plastic waste per unit of product, which is likely driven by the cellulose acetate filters in cigarette butts, which typically weigh about a gram each.

For each convenience item surveyed, the CIL team documented the polymer type and/or material of the packaging (Figure 17).

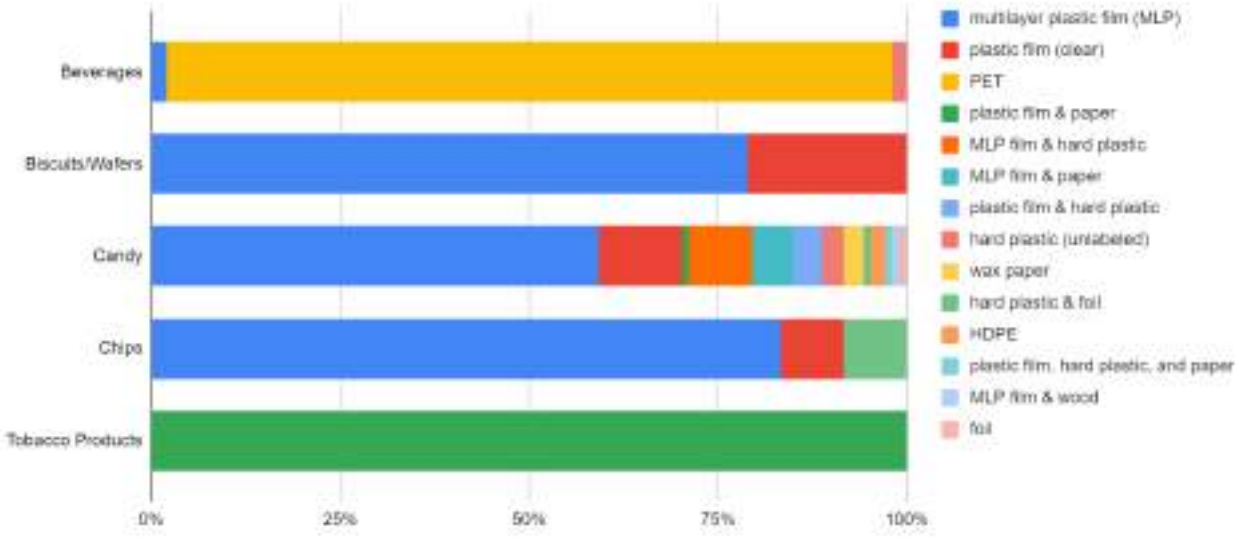

Figure 17: Material breakdown of top convenience items in Dominica

Among beverage products sampled, 91% were packaged in PET bottles. The majority (87%) were packaged in clear PET - among the most readily recyclable and highest-value recycled plastic polymers - while 1.2% were packaged in black PET, 1.2% were packaged in green PET, and 1.2% were labeled as packaged in recycled PET (rPET). The remaining non-PET packaged beverages included those packaged in HDPE (4%), multilayer plastic (MLP) (1.2%), and #7 Other Plastic (1.2%).

Candy products had the highest diversity of packaging material types. The majority (60%) were packaged in MLP film, followed by those packaged in single-layer, clear plastic film (11%), a combination of MLP film and hard plastic (8%), and a combination of MLP film and paper (6%). The remaining material categories, each of which represented <5% of the samples, included plastic film & hard plastic, hard plastic, wax paper, MLP film & wood, plastic film & paper, foil, hard plastic & foil, and a combination of plastic film, hard plastic & paper. The majority of packaging was some types of multi-material combination, which are difficult to recycle and typically have little to no value in recovered waste streams.

Among biscuit/wafer products sampled, the majority (73%) were packaged in multilayer plastic (MLP) film, while the remaining 27% were packaged in single-layer, clear plastic film. Similarly, the vast majority (83%) of chip products sampled were packaged in MLP film, followed by single-layer, clear plastic film (9%), hard plastic & foil (4%), and a combination of hard plastic, foil & paper (4%). All of the 22 tobacco products that were sampled were packaged in a combination of coated paperboard and single-layer, clear plastic film. Multilayer and multi-material packaging can present a challenge to waste management systems and should be targeted for redesign or extended producer responsibility to prevent those items from ending up

in the landfill or in the environment. With a large proportion of candy, chip, and tobacco products coming from Domestic and other parts of the Caribbean (particularly from Dominica, Trinidad & Tobago, and Jamaica), there may be opportunities for regional collaboration around product re-design and recapture for the most problematic packaging types.

Product Design: Restaurants and Food Vendors

In addition to surveying convenience stores, the CIL team surveyed restaurants and free-standing food vendors in each of the 1 km^2 transects areas. Through visual assessments and discussions with restaurant owners, the team assessed the material type for to-go food items like containers (including plates and lids, where applicable), cups, utensils, and straws. In total, the team characterized 108 items in 40 restaurants (Figure 18). This included 37 food containers, 17 straws, 17 cups/beverages, 15 utensils, 16 bags, 3 cup lids, and 3 plates.

Figure 18: Example to-go materials surveyed in Dominica

Across all to-go items sampled, the highest proportion (36%) were made of polylactic acid (PLA), which is an alternative to fossil-fuel-based plastic that can be industrially composted (Figure 19). However, PLA cannot break down or biodegrade naturally in the environment without the high temperatures required for industrial composting. This is likely also the case with to-go items that are labeled as made of cornstarch unless otherwise specified by the manufacturer. The next most common material types among to-go containers were fiber and non-coated paper, which should be backyard compostable if the product labels are accurate. Among the remaining categories of material types, coated paper, other plastic, and polystyrene (PS) will likely need to be disposed of in landfill, while aluminum, PP, and PET are potential candidates for recycling.

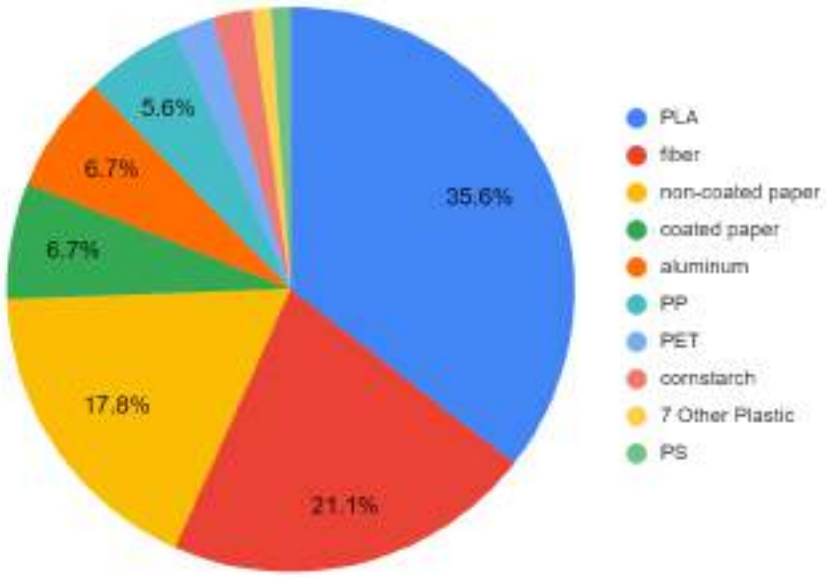

Figure 19: Material breakdown of all to-go items surveyed from restaurants and food vendors in Dominica

When material types are broken down based on the individual to-go item, it is clear that fiber containers are most favorable for food to-go containers and PLA is most favorable for items such as cups, lids, and utensils (Table 5). It's also noticeable where traditional fossil-based plastic, such as PP and PET, are still found among specific to-go items such as straws, utensils, and cup lids.

Table 5: Products and material types surveyed in restaurants and food vendors

Product	Material Type	Number of Observations
To-Go Food Containers (including lids, if applicable)	fiber	19
	aluminum	6
	coated paper	4
	non-coated paper	4
	PLA	3
	7 Other Plastic	1
Cups	PLA	12
	coated paper	2
	paper	1

	PET	1
Cup Lids	PLA	1
	PET	1
	PS	1
Plates	paper	3
Straws	paper	9
	PLA	5
	PP	3
Utensils	PLA	11
	cornstarch	2
	PP	2

This information is also represented visually in Figure 20.

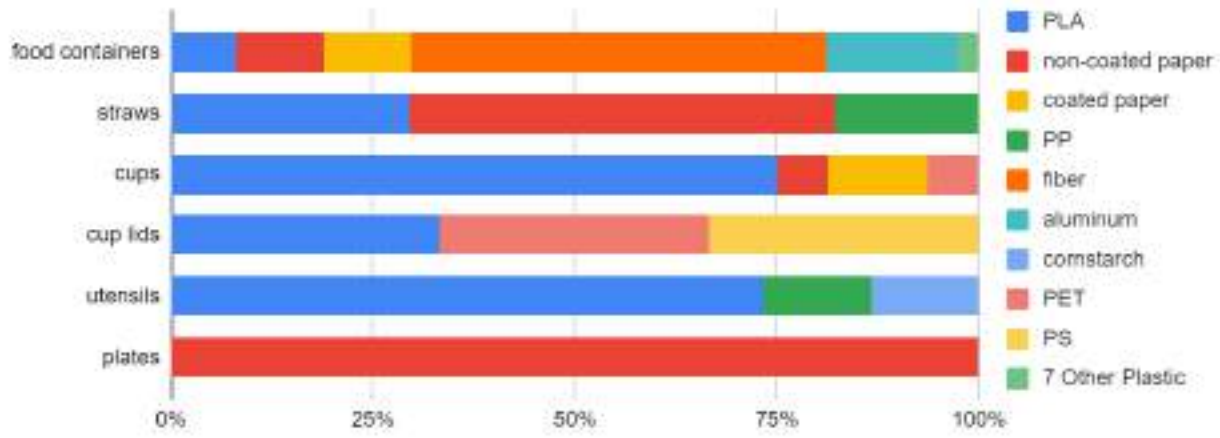

Figure 20: Material breakdown of to-go items surveyed from restaurants and food vendors in Dominica broken down by item type

It can be difficult to identify the manufacturer and country of origin of to-go items without seeing their original packaging; however, several brands (40% of all samples) were clearly shown on the items and the information was available. Of those that could be identified, the largest proportion (18%) were manufactured in and imported from the United States (Figure 21). The second highest proportion among those identifiable were from Dominica, most commonly from the company 100% Green. It should be noted that not all of the products from that company

are manufactured themselves in Dominica, and some are still imported from manufacturers elsewhere. Other importing countries for to-go items included the Dominican Republic, China, and the United Kingdom. Several items listed on the product that they were manufactured in China but did not specify a brand or parent company.

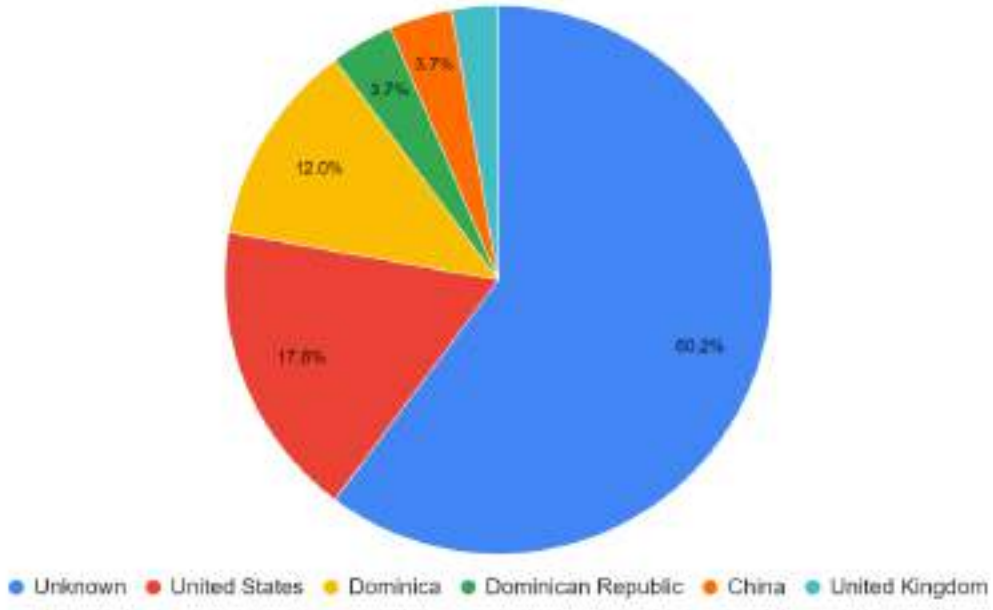

Figure 21: Sources of Plastic Alternative Brands in Food Vendor and Restaurant To-Go Items

The top 10 most common brands that were found for plastic-alternative products among food vendors and restaurants in Dominica, as well as their manufacturing location according to what was listed on the packaging or available online, were as follows (from most to least common):

1. 100% Green (based in Dominica)
2. Prime Ware (based in the United States)
3. Asta (based in Dominica)
4. World Centric (based in the United States)
5. NoTree (based in the United States)
6. Bionature (based in the Dominican Republic)
7. Vegware (based in the United Kingdom)
8. Ingeo (based in the United States)
9. Greenware (based in the United States)
10. Alfreds (location unknown)

The most common brands, among those that were readily identifiable, were also broken down based on the product types in the following Table 6.

Table 6: Common plastic-alternative brands among restaurant food vendor to-go items

To-Go Item from Restaurants & Food Vendors	Most Common Brands (among those identifiable)
Food Containers	Asta, BioNature, NoTree, Vegware, 100% Green
Cups	WorldCentric, Ingeo, 100% Green, Greenware, PrimeWare, Vegware, NoTree
Straws	PrimeWare, 100% Green, Asta, WorldCentric
Utensils	100% Green, Asta, Vegware, World Centric

In 2019, Dominica implemented a Single-Use Plastic (SUP) Ban which bans the import of several problematic plastic items such as expanded polystyrene, utensils, plates, and straws. The ban specifically targeted foodware and food-related single-use plastic items as a starting point for legislative action. The policy was formally announced in the National Budget Address in 2018 by Hon. Roosevelt Skerrit, Prime Minister and Minister of Finance, where he stated:

> *"Therefore, Madam Speaker, consistent with the Government's vision to create the world's first climate resilient nation, our designation as "The Nature Isle" and our commitment to protect Mother Earth, effective 1st January 2019, a number of items considered to be inimical to the environment will be banned. (Government of Dominica, 2018)"*

The process started in December 2018 with a 0% duty on the importation of authenticated biodegradable products (including lids, cups, single-use containers, cutlery, and drinking straws) and on the importation of reusable shopping bags. In January 2019, the ban went into effect on the importation of non-biodegradable single-use plastics from all ports of entry in Dominica (Clayton et al., 2021). Education information was posted across departments and venues (Figure 22) and reusable shopping bags were provided to residents.

Figure 22: poster with information on the Single-Use Plastic Ban

Progress since the implementation of the ban is evident, particularly in the small quantity of fossil-based single-use plastic, such as PP, PET, and PS, that was observed among to-go items (less than 6% of the sample respectively for each material type). However, stakeholder interviewees noted that the language on the single-use plastic import ban is based on the product labeling and not on the product polymer itself. This was observed in some to-go items and grocery bags that were labeled as PET or LDPE that are biodegradable, which are likely actually fossil-based and not biodegradable or are oxo-degradable and will simply break up into microplastics over time. There are opportunities to improve upon the existing legislation and specific policy language to ensure that the single-use plastic ban is enforced as it was intended and that undesirable products such as this do not continue to make their way through importation.

Product Design: Grocery Stores

In addition to surveying material types from common items found in convenience stores and among to-go items in restaurants and food vendors, the CIL team surveyed 9 Large Grocery Stores across the island and looked at the material type of packaging of several key household items. This included: Cooking Oil, Eggs, Greens, Laundry Detergent, Milk, Rice, and Sugar (Figure 23).

Figure 23: Example of grocery store items surveyed in Dominica

Among all household items surveyed in grocery stores, the most common packaging material type was single-layer plastic bags (Figure 24). These items are most likely to end up in landfill or in the environment as they are often lightweight and low-value for recycling. The following two most common material types among household items (both comprising 15% respectively of the sample) were PET and HDPE, which are typically among the highest-value plastic polymers for recycling.

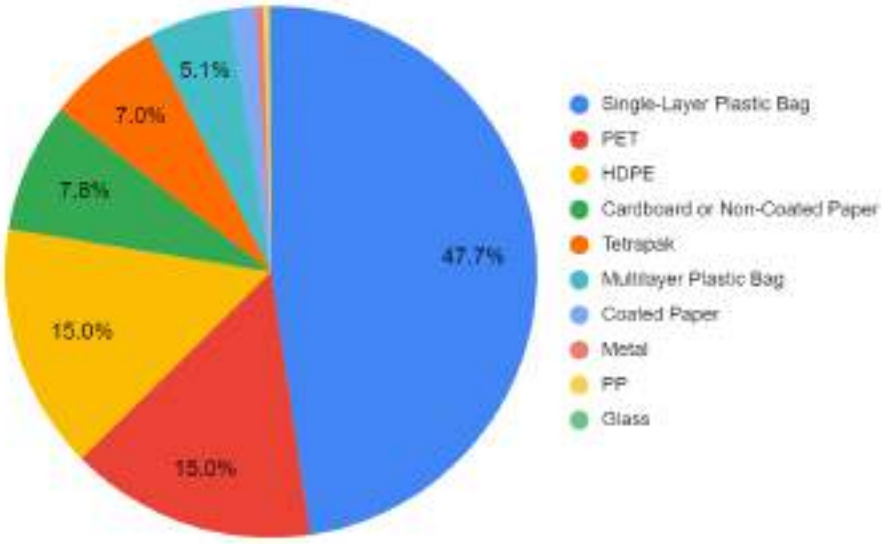

Figure 24: Material breakdown of staple item packaging surveyed from grocery stores in Dominica

When investigated by item type, laundry detergent products had the highest diversity of material types in their packaging (~40% HDPE, 36% MLP bag, 22% PET, 2% PP) (Figure 25). Cooking oil also had a high diversity of material types, though less evenly distributed than those found in laundry detergent (~82% PET, 13% HDPE, 4% metal, 1% glass). All of the vegetable greens

surveyed were packaged in single-layer plastic bags, as were the majority of rice products (97%) and sugar products (86%). Eggs were nearly evenly split (50%/50%) between those packaged in single-layer plastic bags and those packaged in cardboard containers. Similarly, milk was nearly evenly split (50%/50%) between being packaged in HDPE bottles and Tetrapak.

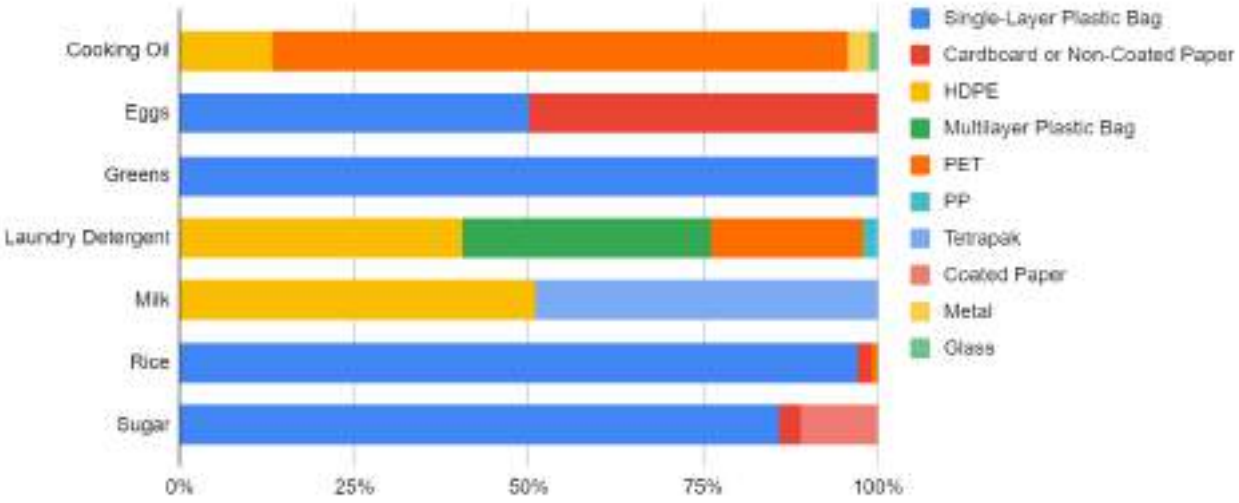

Figure 25: Material breakdown of staple item packaging surveyed from grocery stores in Dominica based on item

Use

The intention of the Use section of the CAP is to characterize trends around use and reuse of products within the community, as well as identify alternatives and their cost comparisons with traditional single-use items. Among the 9 large grocery stores that were sampled as outlined in the Product Design section, 107 individual SUP and plastic alternative items were identified and surveyed. This consisted of 44 sandwich bags, 22 cups, 13 food containers, 12 plates, 9 utensils, 5 straws, and 2 shopping bags (Figure 26).

Figure 26: Example of single-use plastic options available in grocery stores (left) and alternative options available in grocery stores (right)

Among all SUP and alternative items, 14 different material types were identified. Among the alternatives, five different labels/nomenclatures were identified to distinguish the materials, including compostable, biodegradable, bio-disposable, environmentally friendly, and reusable (Figure 27).

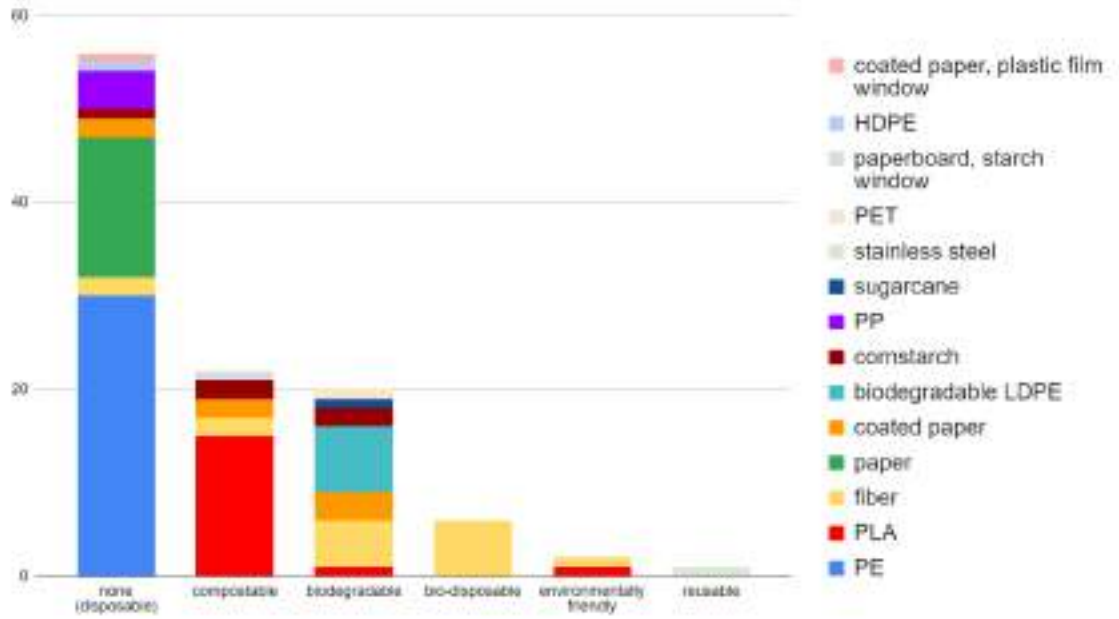

Figure 27: Material of Plastic & Alternatives Items in Grocery Stores, separated by Use Type

The current SUP ban in Dominica applies only to foodware and does not include household items that are sold in grocery stores. As such, there were still many single-use and disposable plastic items still available in grocery stores in Dominica, particularly among sandwich bags and cups. The majority (54%) of those single-use items were made of polyethylene (PE), as well as paper (27%), PP (7%), and several others. The vast majority (68%) of household items in grocery stores that were labeled as compostable were made of PLA, but compostable items were also found in the form of fiber, coated paper, cornstarch, and a combination of paperboard and starch. PLA items were also found labeled as biodegradable and environmentally friendly. All items labeled as bio-disposable were made of fiber and only one reusable option was found in the form of a stainless-steel container. The largest proportion of items labeled as biodegradable (35%) were made of biodegradable LDPE, which is most likely oxo-degradable and does not fully biodegrade in the environment. The wide variety of materials and labels can be confusing to consumers and an updated labeling process should be considered.

Among SUP alternatives identified in the grocery store surveys, those labeled as biodegradable or a form of organic material (e.g., natural fiber or wood) were on average 1.13 times more expensive than the standard SUP options (Table 7). Those labeled as compostable plastic were 2.06 times more expensive than SUP and those labeled as reusable or refillable were nearly 67 times more expensive.

Table 7: Cost comparison of alternatives and single-use plastic options in grocery stores

Plastic Alternative Label Designation	Average Cost per Unit of Single-Use Plastic item (e.g., straw, utensil, sandwich bag)	Average Cost per Unit of Alternative	Cost Difference for Alternative
Biodegradable or Organic Material	$0.45	$0.51	1.13 x
Compostable Plastic	$0.45	$0.93	2.06 x
Reusable/Refillable	$0.45	$30.00	66.67 x

Similar to the findings from the Input and Product Design sections, it is important for stakeholders in Dominica to understand which countries and brands are most heavily importing alternative products, particularly in light of the SUP Ban and potential similar bans in the future. Among brands that were identifiable, the largest proportion (around 36%) of alternative items came from the US. Importantly, around 15% came from Dominica, highlighting further opportunities for domestic business models around alternatives that support policies and bolster the local economy (Figure 28).

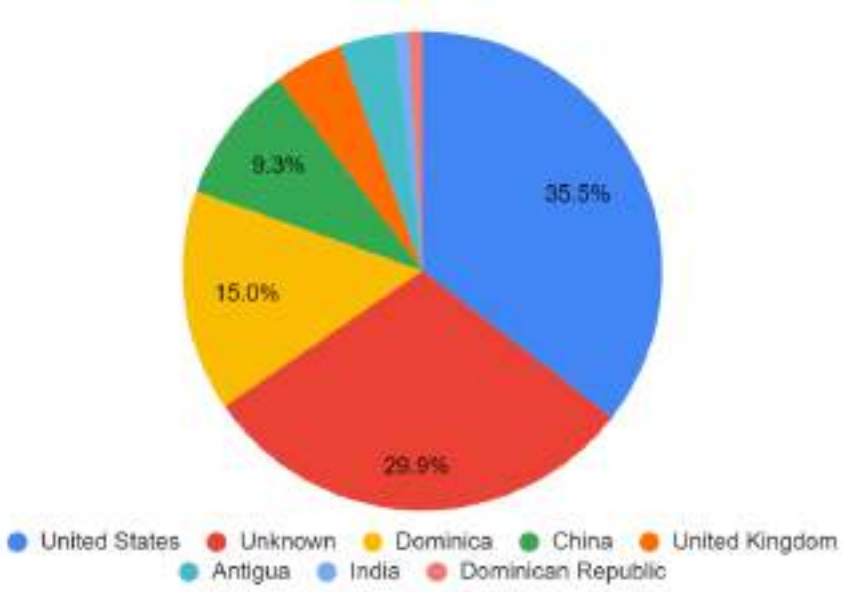

Figure 28: Sources of all Plastic Alternative Brands found in Grocery Stores

When observed by use type/labeling, opportunities and potential monopolies are apparently for different regions. For example, while they comprise a small number of samples, it's clear that nearby Caribbean nations such as the Dominican Republic and Antigua are potential markets for compostable alternatives (Figure 29). The data also shows that most of the SUP household items sampled that are still entering grocery stores in Dominica are coming from the United States, China, and Unknown or Unlabeled brands/locations. It is worth mentioning that a small amount of those SUP items is also coming from Dominican companies, which could potentially present EPR or sustainable business opportunities for those brands.

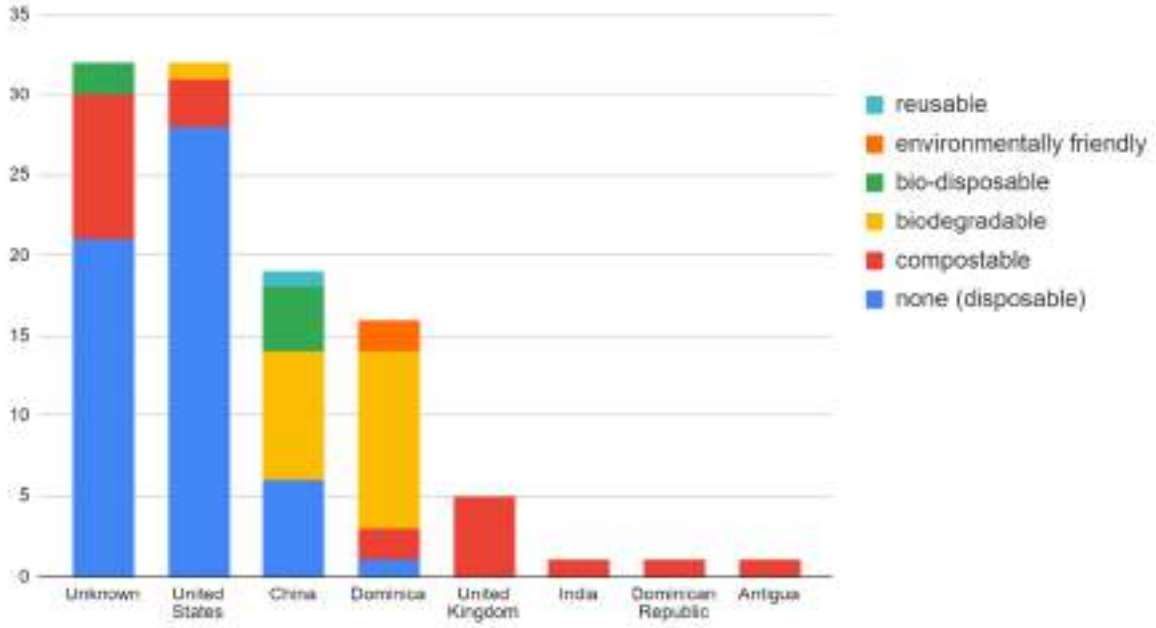

Figure 29: Sources of Plastic & Alternative Brands in Grocery Stores, separated by Use Type

All Brands of Alternatives available in Grocery Stores (identifiable):

1. Fresh Market
2. Asta
3. Vegware
4. China Town Resources Ltd
5. Essential Everyday
6. World Centric
7. Best Choice
8. 100% Green
9. Umite Chef
10. Shoppers Value
11. Party World
12. NoTree
13. Home Smart
14. Greenware
15. Diamond
16. BioNature
17. All Best Inc.

Only one of the large grocery stores sampled offered a bulk purchasing option (Figure 30), though customers were required to use the single-use plastic bags provided. Refillable options or bring-your-own-container options were not identified in any of the stores, and several

stakeholders mentioned that reuse and refill are not commonly practiced in Dominica, in part due to health concerns. Some interviewees noted that in the past, Dominica had a local manufacturer of jams, jellies, juices, and other household items that were packaged in glass and that offered a deposit/return scheme that worked well, but that has since closed and all items have largely been transitioned to plastic packaging and import. In some stores, larger sizes of products are available in bulk, but most are re-packaged into smaller plastic bags for distribution. Many roadside vendors also re-package items into smaller plastic bags.

Figure 30: Example of a bulk purchasing option at a grocery store in Dominica

From all convenience stores, grocery stores, and restaurants/food vendors sampled as outlined in the Product Design section, 22 distributed single-use to-go bags (Figure 31).

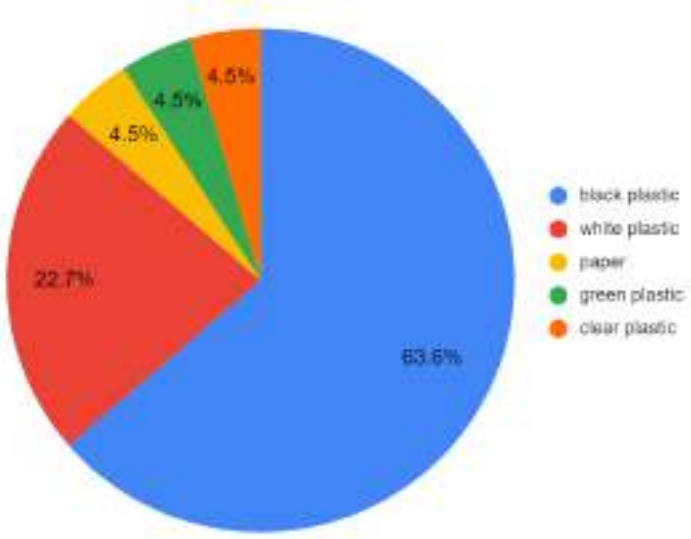

Figure 31: Material breakdown of single-use to-go shopping bags distributed in convenience stores, grocery stores, and restaurants/food vendors in Dominica

Among locations that handed out to-go bags, the majority (64%) used predominantly black plastic bags, often labeled as biodegradable LDPE, though they are likely oxo-degradable (Figure 32).

Figure 32: Example of black plastic to-go shopping bags available at stores in Dominica, labeled "biodegradable HDPE"

Only around 5% of locations predominantly distributed to-go bags that were not plastic (paper), though several did offer smaller items, such as individual candies, in paper bags in addition to the SUP bags. Around 33% of to-go bags were made of HDPE, the majority of which were made of a white plastic polymer, but green and clear HDPE was also observed. One of the grocery stores sampled charged customers an additional $1 if they opted to take a plastic to-go bag, and 1 grocery store offered reusable bags at checkout for an additional $3 each. It is clear that, despite

the import ban, plastic bags are still a waste and environmental challenge in Dominica, as 178 plastic bags were found in the litter surveys (discussed further in the Leakage section).

The current SUP ban in Dominica includes foodware items, such as cups, forks, plates etc., but does not specifically include SUP shopping bags. This could present an opportunity to strengthen plastic policies domestically. Among the 20+ Caribbean countries that have implemented some form of national SUP policy, most include plastic bag bans. A significant decrease in the number of plastic bags that end up as litter in those countries has been observed since the policy implementation, particularly in Antigua, Aruba, and Panama (Courtene-Jones et al., 2021). This suggests that the policies are working and Caribbean SIDS are taking the right initial steps, though more work is needed. Several other countries, including Antigua and Barbuda, Belize, and Saint Vincent and the Grenadines have policies that target problematic litter items such as expanded polystyrene (EPS) (Brooks et al., 2020).

Another potential opportunity for reduction and reuse in Dominica lies in local juices. Currently, local juices are bottles and distributed in clear PET bottles with attached PP caps that are opened by pulling off a small plastic tab (Figure 33). This is a popular consumer good that you can find in convenience stores, roadside stalls, and most food vendors and restaurants. In addition to a high abundance of plastic PET bottles found in the litter surveys, many bottle caps, plastic cap tabs, and hard plastic fragments that may have originated from these or similar products were found littered across the island. However, while the disposable plastic tab that keeps the lid closed was readily identified in the litter, entire bottle caps were more commonly identified in the litter from other brands and not from these local juices. The design of the attached PP caps demonstrates the capacity of a local entity to make design choices that are different from multinational corporations that could be beneficial to the environment and to recycling. Further, there may be local business opportunities for collecting back these local juice bottles, using a different material, washing and reusing the bottles, or otherwise to reduce the likelihood of the bottles or caps ending up in the environment.

Figure 33: Example of local juice bottle

Beyond SUP shopping bags and bottles, there are other national policy interventions that could minimize the use and disposal of problematic plastic items in Dominica. For example, there are currently no EPR or packaging legislations in Dominica, whereby consumers would be able to see a direct benefit of returning commodities to the parent companies and potentially receiving incentives such as coupons, rebates, or otherwise. Similarly, there are no existing policies that aim to reduce the amount of plastic that is produced and manufactured upstream, beyond encouraging reuse of existing plastic items. Several studies have emphasized the need to reduce plastic usage and waste generation as a primary method of addressing plastic pollution in Caribbean SIDS, and policies should be enacted to reinforce that prioritization (Busch, 2022; IUCN, 2024; Kanhai et al., 2024).

One of the challenges with the existing national plastic policy is related to the HS Import Codes. Historically, it has reportedly been difficult for the government to differentiate between the import of standard plastic versus compostable or biodegradable plastic, and companies that were trying to import alternatives after the ban would have to send a sample to the Dominican Board of Review for approval. However, the process is difficult to follow and certain items have been able to slip through due to their labeling strategies, such as items labeled as biodegradable LDPE that may in fact be oxo-degradable. One way to address this might be focusing the import ban on the polymer type or resin code instead of the product label, though this would require stricter monitoring and enforcement. This is something that the Bureau of Standards could potentially support. Enforcement of policies also poses a challenge in Dominica. A Waste Control Bill was introduced in 2019 to provide enforcement and compliance support for the SUP ban, but as of December 2023 that still has not passed. There have reportedly been legislative delays in the Caribbean and the COVID pandemic was a higher priority for several years. It would be beneficial to bring local leaders together in Dominica to revisit this bill and re-prioritize passing it in the coming year.

Collection

Investigation into the waste collection methods of Dominica was conducted through stakeholder interviews, site visits to waste collection sites, and reviews of existing waste characterization and literature on the topic.

The Latin America/Caribbean (LAC) region generated an estimated 231 million tons of waste in 2016 alone, representing 11% of global waste generation, and has the third highest per capita waste generation rate (0.99 kg/person/day) after North America and Europe/Central Asia (Kaza et al., 2018). While the waste collection coverage for LAC is relatively high at 84% on average - about 50% of which ends up in a sanitary landfill and less than 5% recycled - the average coverage for rural areas drops to 30%, and over 320,000 tons of plastic is estimated to go uncollected every year across the Caribbean (Kaza et al., 2018; Diez et al., 2019). Studies have also highlighted gender inequities and higher impacts of plastic pollution on women in Caribbean SIDS, particularly through discrepancies in access to personal protective equipment in the informal waste sector, in disproportionate exposure to the health hazards of plastic through domestic care work, in the unique roles that women play in fisheries, and in a general lack of female perspective when it comes to design, implementation, and evaluation of policies (Arnould et al., 2023). In 2019, it was found that among the top thirty global polluters per capita, ten were from the Caribbean region, and this led to global media attention on the role of the Caribbean in the plastic pollution crisis (Ewing-Chow, 2019).

Per capita waste generation rates in Dominica in 2018 were around 0.5 kg/person/day, lower than the global average at the time of 0.74 kg/person/day and the LAC regional average of 0.99 kg/person/day (Kaza et al., 2018). Dominica also has among the lowest per capita waste generation rates for Caribbean nations and territories, which average around 1.6 kg/person/day and reach highs of 4.46 kg/person/day in the U.S. Virgin Islands, 3.75 kg/person/day in the British Virgin Islands, 3.43 kg/person/day in the Cayman Islands, 3.28 kg/person/day in Puerto Rico, and 2.91 kg/person/day in Aruba (Kaza et al., 2018). In 2018, it was estimated that Dominica had a higher percentage of plastic in the waste stream at 16%, compared to the global and LAC average at that time of ~12% and the Caribbean average of ~14% (Kaza et al., 2018; Brooks et al., 2020). A more recent waste characterization at the landfill in Dominica found that plastic comprised around 24% of all solid waste collected in the country (Figure 34; Seureca Veolia & Unite Caribbean, 2023). It's estimated that around 2,200 metric tons of waste was generated in Dominica alone in 2020, and it's been reported that Dominica has the lowest percentage of waste collected in the Eastern Caribbean (UNEP/OCHA, 2017; Kaza et al., 2018).

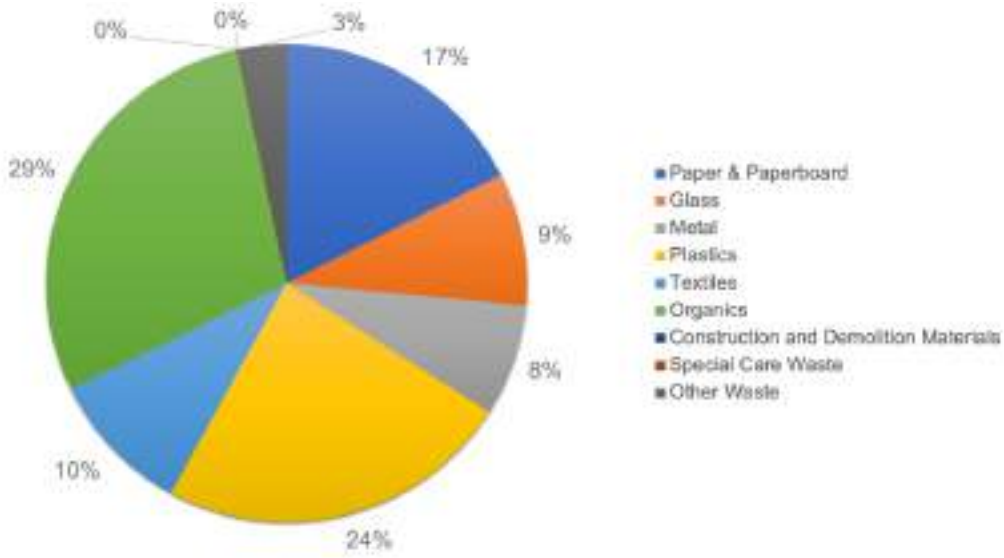

Figure 34: Dominica solid waste composition July 2023 (Data Source: Seureca Veolia & Unite Caribbean, 2023)

Household municipal solid waste (MSW) collection in Dominica is conducted by DSWMC across the entire island. There are around 75 staff at DSWMC and the majority are conducting waste collection. DSWMC reportedly has two collection trucks provided by Japan and one recycling truck with separate compartments provided by Switzerland, which are responsible for servicing the whole country. Reportedly 100% of Dominica residents have access to curbside MSW collection and DSWMC collects all household waste as well as recyclables (including glass, plastic, cans, and paper) Monday through Friday. There is currently no mandate for bins used for household waste collection, and DSWMC will collect waste from any receptacle provided (most households use blue barrels, Figure 35, left). Some neighborhoods have public waste collection centers (Figure 35, right) where residents can deposit their trash in a centralized location for collection by DSWMC, as opposed to having individual household containers. Some stakeholders mentioned that put-out for curbside recycling is generally very low.

Figure 35: Community and residential waste collection center recently emptied (left) and community waste collection center that is full (right)

DSWMC also handles public waste bins in the larger cities across the island. These are predominantly standard green bins along sidewalks (Figure 36, left) and larger trash and recycling bins in public areas like beaches and parks (Figure 36, middle). However, DSWMC is in the process of replacing many of those bins with segregated waste bins that have been donated by OECS and are being shipped from China to enhance source segregation, composting, and recycling (Figure 36, right). As of December 2023, several of these bins could be seen at the airport and at public events in Roseau.

Figure 36: Public trash cans and collection bins in Dominica

DSWMC also faces the challenge of stray dogs or people getting into trash bins and ultimately spreading litter around the vicinity (Figure 37).

Figure 37: Collection bin in Roseau that had been rummaged through

In addition to DSWMC household collection, there are two private hauling companies in Dominica that collect commercial and industrial waste across the island, as well as a small number of informal, independent waste workers that collect items such as white products, bulk items, and others. Some stakeholders reported that they had witnessed some waste haulers dumping waste on the side of the road or down one of the many large ravines in the inland portion of the island. There is only one landfill on the island and it can be a long distance for some haulers to travel, which may incentivize disposing of the waste elsewhere.

For beverages that were sampled in Dominica as described in the Product Design section, it was also documented whether the labels and/or bottle components themselves contained any instructions related to waste collection or disposal (Figure 38). The most common labeling (25% of beverages) was the chasing arrows symbol, though not always accompanied by resin number or location-specific recycling instructions. The second most common (20% of beverages) had no labeling for disposal. Labeling was also analyzed based on the manufacturer and parent company locations of the beverage products. Among those from Dominican manufacturers, only one sample had a label with disposal instructions, and it was the Throw In Bin symbol. The Chasing Arrows and the Throw In Bin symbols were the most internationally used, particularly those from Trinidad & Tobago. The circular arrow Recirculate symbol was observed only in beverages from French countries. Money-back offers were only observed in beverages from Jamaican manufacturers. Manufacturers from the US had the highest diversity of label type (seven total, including ‘none'), and Saint Vincent and Jamaica had the second highest diversity of label type (five total, including ‘none’). Around 5% of beverages noted on the label that they were made of post-consumer recycled (PCR) content, which was only observed in US and UK manufacturers.

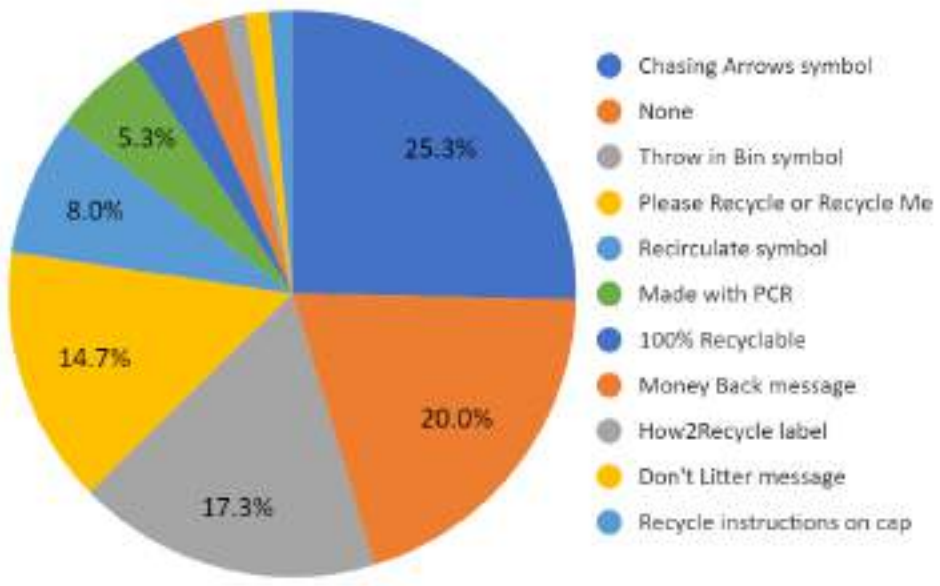

Figure 38: End-of-life instructions observed on labels and caps of Beverage brands in Dominica

Several stakeholders mentioned that public awareness and education are vital for the success of future waste management initiatives such as separating at source, increasing recycling, and using SUP alternatives. As part of that process, it may be beneficial to look into standardizing labeling, language, and instructions around what types of materials should be disposed of in which manners in Dominica, based on the local waste management infrastructure, capacity, and markets.

End of Cycle

The waste management infrastructure of Dominica has changed over time as the local economy, materials, and management methods have evolved. Dominica was largely an agricultural economy through the 1960s and 1970s, so MSW was mostly organic and the import of consumer goods from other countries was relatively low. During that time, open landfills and illegal dumping were reportedly the predominant waste management methods. When Hurricane David struck the island in 1979, plastic packaging started arriving in Dominica from AID groups, and around that time single-use plastic was being heavily marketed and advertised globally as synonymous with modernism, convenience, wealth, and status. As Dominica was rebuilding and modernizing after Hurricane David, it relied more and more heavily on imported plastic products. While the banana agriculture economy was booming in the 1970s and 1980s, more money coming to the island resulted in higher consumerism, which meant more packaging and products, but still a general lack of adequate SWM infrastructure to handle those materials. After Dominica gained independence in 1978, the banana industry started to falter, as the UK sought out other islands in the Caribbean for sourcing. The island however remained heavily dependent on imported plastic consumer items, which were becoming more plentiful and cheaper on the global market over time with the boom of the plastics industry.

In 1999, the Dominica government commissioned the Fond Cole scientific landfill for household waste in order to move away from open dumping and address increasing waste management needs. At the time, a Material Recovery Facility (MRF) was proposed to accompany the landfill to handle recyclables, but the MRF didn't end up being developed, reportedly due to procurement issues. This meant that there was no waste diversion put into place when the landfill was built, as was originally intended.

Following the devastating impacts of hurricanes Maria and Irma in 2017, Dominica invested heavily in resilience and disaster preparedness. The Solid Waste Management Act of 2002 was one of few pieces of national legislation at the time that specified the requirement of disaster preparedness response plans by licensees. Much of the solid waste management infrastructure on the island, including a compactor funded by the Caribbean Development Bank, a PET shredder funded by the Pan American Health Organization, a small PET-dedicated truck funded by the

Swiss Government, a biodiesel facility financed by the Global Environment Facility and the United Nations Development Programme, and the structure of the Fond Cole landfill itself, sustained initial damage in tropical storm Erika in 2015 and were further damaged by the 2017 storms. Some also require maintenance or parts that are not available on-island and have since fallen into disrepair. While the landfill was originally intended to reach capacity around 2022, the surplus of waste from Hurricane Maria essentially saturated it in 2017, and there are no other viable locations for a landfill on the island (UNEP/OCHA, 2017).

With the landfill already exceeding its expected fill date and having little to no increased land area into which to expand, DSWMC is dedicated to pursuing waste diversion activities such as waste separation, recycling, composting, and others. There is a strong need for a long-term, sustainable vision and plan for domestic solid waste management in Dominica, with an emphasis on reduction and reuse.

End of Cycle: Landfill

The Fond Cole landfill, the only scientific landfill in Dominica, was originally built with funding support from the Norwegian Ministry of Foreign Affairs under the "Tackling Ocean Pollution from Turf to Surf" initiative (Figure 39). While it was initially commissioned in 1999, operations officially opened at the landfill in 2005. It covers an area of roughly 18 acres just north of the capital on the west coast and accepts waste from across the island, including industrial waste, green waste, commercial waste, household and institutional waste, and hazardous healthcare waste (DSWMC, 2023).

Figure 39: Weighing station at the entrance to the Fond Cole landfill

The landfill was originally estimated to reach capacity in 2022. Phase 1 and Phase 2 cells of the landfill are completely full and DSWMC is planning to expand to a Phase 3 cell that is currently housing a large amount of metal scrap (Figure 40). That new cell is expected to extend the life of the landfill by an additional 15 years if waste production rates remain stable; however, there is limited land nearby for expansion and strict permitting requirements that prevent new landfill space from being developed.

Figure 40: Area of the Fond Cole landfill currently planned to become Phase 3 expansion

The Fond Cole landfill is lined and properly covered using soil that is excavated on-site. The leachate is collected in a pond on site but it is not treated. Landfill gas is regularly vented from the landfill but is not formally collected. There is some privately owned equipment at the landfill that DSWMC and the Government of Dominica are trying to purchase, such as backhoes and crushers for cars, and some equipment is borrowed from OECS, such as trucks and balers (Figure 41).

Figure 41: Photos from the Fond Cole landfill

The COVID-19 Pandemic put significant stress on the waste management systems of Dominica, including the landfill. Residential waste quantities remained the same, if not increased, but DSWMC was also responsible for collecting and managing the biomedical waste from all of the formal and pop-up health centers across the island. Stakeholders reported a significant increase in personal protective equipment (PPE) littered on the ground during that time.

The landfill does not currently accept construction and demolition (C&D) waste, which presents a challenge for open and informal dumping in Dominica. It would be beneficial for the landfill to develop a separate waste stream or collection point for C&D materials, or potentially arrange regional collaborations for the disposal, reuse, and recycling of such materials. Another challenge in Dominica is derelict automobiles that are often left on the side of the road. There are disposal options at the landfill, but there is little space and people are not always able to transport the automotive waste to the landfill. This is another waste stream that should be targeted for diversion, recycling, and repurposing in the future.

End of Cycle: Recycling

While some infrastructure exists to support recycling in Dominica, it does not match the current need and demand, and the local recycling economy is feeling the pressures of the changing global recycling market. There is one baler at the Fond Cole landfill, which was provided by the European Union. There is also one PET shredding machine that was provided by Venezuela, but it is not currently in use because recycled PET is not currently being exported. Dominica previously sent its recycled plastic content to the US and Indonesia, but operations have stopped. The landfill currently houses over 2 dozen 4x4 ft bales of PET and a growing pile of unsorted plastic recycling, likely over 40 ft tall, which has been accumulating since 2015 (Figure 42). This has mostly come from local MSW. At the moment, DSWMC and the Dominican government are unable to export that content for recycling, citing that it is too costly of a process and does not make financial sense with the current global recycling market. In the past, metal scrap from Dominica was sent to recycling markets in Trinidad and parts of Asia, and plastic had gone to the US and Indonesia, but those operations have halted. Stakeholders familiar with the local waste management and recycling industry noted that the War in Ukraine has also had an impact on their plastic recycling markets and has increased fuel prices, which can be detrimental to economies of SIDS that rely on long-distance transport for goods and trade.

Figure 42: Field photos from the Fond Cole landfill, showing baled PET bottles and those waiting to be baled

Plastic recycling is not the only market that has faced challenges in Dominica. In the past, Dominica sent recyclable heavy metals to Asia, but that operation has also ceased due to the high cost of fuel and low returns for sold material. E-waste and batteries are the only recyclables that Dominica is currently exporting, which are currently being sold to a US-based company through a recycling broker in St. Maarten. There is also a domestic recycling process in place for used oil on the island, largely in partnership with tropical shipping organizations, which has been reportedly working well.

Stakeholders reported that some of the most abundant imports to Dominica are PET bottles of water, juice packaged in Tetra Pak and PET, and household goods in HDPE containers. This was also reflected in the store surveys conducted for the CAP as well as the most recent waste characterization conducted at the landfill, which found 24% of collected solid waste to be plastic, around a quarter of which was PET (Figure 42). It would therefore be beneficial for Dominica to prioritize the repurposing and reusing of plastic waste into benefits and commodities.

> *"Dominica needs to start repurposing its plastic waste into a commodity. Dominica imports a lot of plastic, even durable things like park benches, that they could potentially be making on-island with their plastic waste, instead of exporting it for recycling. I would rather it turn into a physical commodity that the island can use directly and offset some plastic imports." - Local Government*

A recent solid waste composition study in Dominica found that around 24% of all plastic collected is clear PET containers and around 8% is HDPE containers, both of which are readily

recyclable and are among the strongest and most cost-effective recycling markets (Figure 43). The study also found that over half (53%) of the plastic waste collected is film plastic, which is among the most difficult and least cost-effective plastics for recycling. While polymers such as PET and HDPE could be prioritized for recycling, difficult-to-recycle plastics such as films should be prioritized for product redesign, EPR, or other interventions focused on reduction and alternatives.

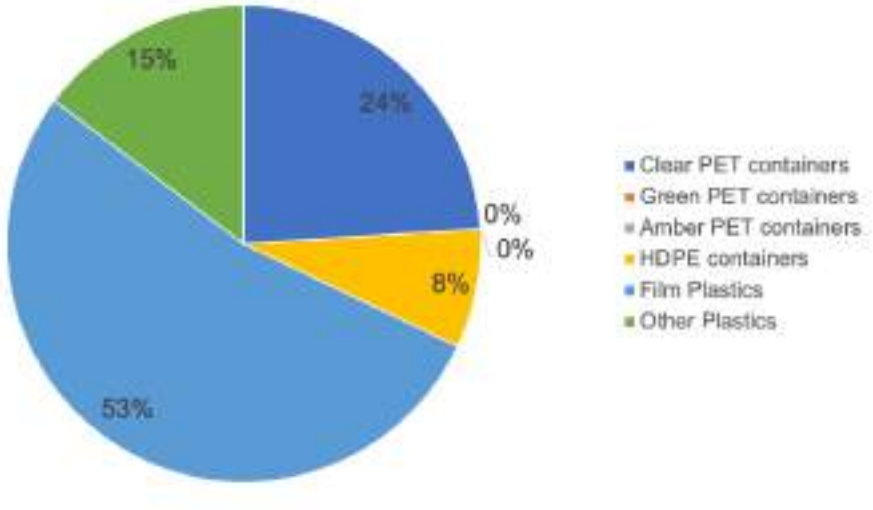

Figure 43: Dominica's Plastic Waste Stream Composition July 2023 (from Seureca Veolia & Unite Caribbean, 2023)

Similarly, the waste characterization also found that PET items in the municipal waste stream in Dominica represent a higher proportion of the recyclable waste by ton, particularly when compared to film and other plastics. This further emphasizes the opportunity to target the >90 tons per year of recyclable PET and HDPE collected in Dominica for effective recycling markets. If source separation of waste were implemented, then the further >400 tons per year of PET and HDPE in municipal solid waste that is not currently deemed recyclable could also be recovered. The study also found that film plastics, which are most difficult to manage and recycle, comprise the highest quantity by tonnage of plastic in the municipal waste stream (50.73%), despite their lightweight format (Table 8).

Table 8: Dominica's Plastic Waste Composition in tons per year based on 2022 quantities (adapted from Seureca Veolia & Unite Caribbean, 2023)

Material Type	Tons Per Year Municipal Waste	Tons Per Year Recyclable Waste	Total Tons Per Year	Percentage of Waste Stream
Clear PET Containers	385.2	65.3	450.5	26.10

Green PET Containers	0.0	1.2	1.2	0.07
Blue PET Containers	0.0	0.0	0.0	0.00
Total PET Containers	385.2	66.5	451.7	26.17
HDPE Containers	128.4	26.6	155.0	8.98
PP Plastics	0.0	0.0	0.0	0.0
Polystyrene	0.0	0.0	0.0	0.0
Film Plastics	850.7	25.4	876.1	50.73
Other Plastics	240.8	2.4	243.2	14.08
Total	1605.0	121.0	1726.0	100

Another beneficial finding of the 2023 waste characterization in Dominica was that the most commonly found clear PET containers in the recycling stream were from local companies, predominantly Trois Pitons and Quenchi (Figure 44). As these items were also readily identified in both the store and litter surveys from the CAP, this highlights the opportunity to engage with local distributors and manufacturers to encourage source separation of waste, collection, recycling, and potentially reuse and redesign of products so that they are less likely to end up in the environment and more likely to remain in the economy.

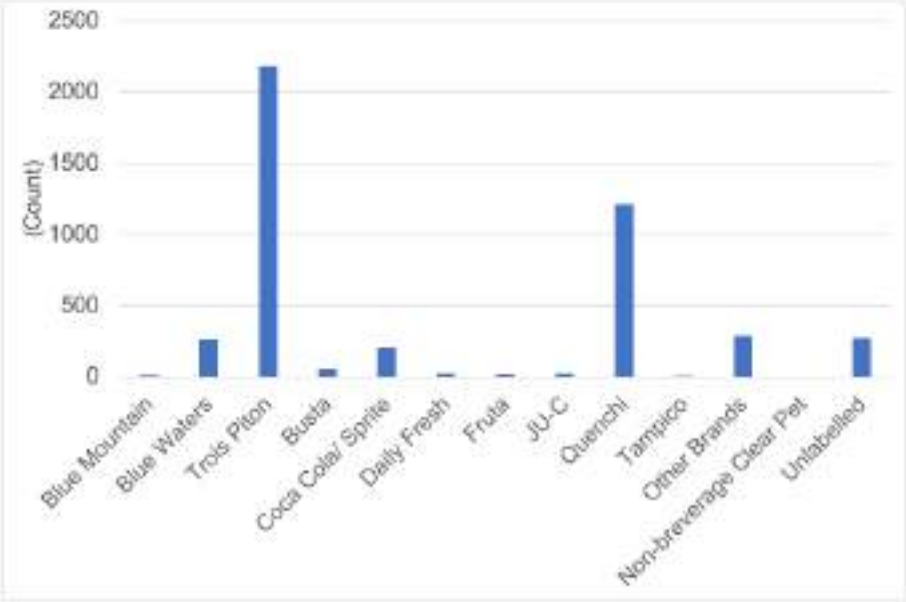

Figure 44: Dominica's composition of clear PET containers within recycling stream (from Seureca Veolia & Unite Caribbean, 2023)

In recent years, DSWMC proposed a $1M concept for a material recovery facility (MRF) to be designed at the landfill. The original intention was to have the MRF work in conjunction with the Fond Cole landfill when it was originally built. The proposal received high reviews in the process of government review, but funding was not awarded. Coca-Cola also invested in a baling and shredding machine for the landfill in the past, but interviewees recounted that it arrived with a missing part and was never repaired, and it is currently not functional. Having proper recycling infrastructure - as well as skills and knowledge for upkeep and repairs of that infrastructure - coupled with continued support, incentives, and outreach for source separation of household waste, could dramatically increase the quality and quantity of plastic recycling in Dominica and could help drive local and regional recycling markets.

In July 2023, Dominica and Grenada joined a pilot project Recycle OECS whereby DSWMC and Grenada Solid Waste Management Authority are developing Model Demonstrations for reducing plastic waste on their respective islands. To date, DSWMC has supported a waste characterization study at the landfill, held several meetings and convenings to engage local businesses in recycling practices, and is rolling out a Zero Waste Schools program and other education, outreach, and messaging around sorting at source and supporting recycling. This is part of a larger EU Zero Waste Initiative for the Eastern Caribbean that is being implemented by the OECS Commission in partnership with Agence Française de Développement (AFD). The pilot runs through December 2024.

There is an opportunity for DSWMC and the government in Dominica to be a leader for circular economy efforts in the Caribbean. Several other analyses and initiatives have identified the benefits of regional recycling and cooperation in the Caribbean to build a circular economy, including reports from Saint Lucia, Grenada, and Antigua & Barbuda, the IUCN Plastic Waste Free Islands Initiative, and the AICS Closing the Caribbean Plastic Tap project (Mittempergher et al, 2022; Raes et al., 2022, IUCN 2024). It will be critical to identify economies of scale and strategic regional collaborations going forward to maximize waste diversion and processing and move towards a system that reduces the generation of waste upfront.

End of Cycle: Composting

As was evident in the store and restaurant surveys across the island, there has been an influx of compostable materials into Dominica in recent years, in part due to the import ban for single-use plastics. However, the waste management infrastructure does not currently match the supply of compostable materials that consumers are using. For example, many hotels and local restaurants have switched to PLA instead of single-use fossil-based plastic for their cups, but that material requires specific conditions for industrial composting and proper management and cannot break down or biodegrade in the natural environment. Many of those items were also observed in litter surveys, meaning that those items are still ending up in the environment. If they are properly discarded, then they end up in the landfill, where they could potentially be contributing more heavily to GHG emissions than standard plastics, and where they are adding to the dwindling capacity of the landfill (Roberts, 2021).

Anecdotally, many consumers and business owners alike were not aware that compostable plastic such as PLA required industrial composting, or that it needs to be processed any differently than organic material that will eventually break down in the environment or in the landfill. If not addressed, increased litter of food items made from compostable plastic and increased GHG emissions from the landfill could potentially become an unintended consequence of the single-use plastic import ban. As such, it would be worth exploring opportunities for industrial composting infrastructure in Dominica, in addition to prioritizing reduction and reuse instead of switching to alternative materials as much as possible. This further emphasizes the importance of enforcing the import ban as it was intended and ensuring that mislabeled polymers and products are not entering Dominica and potentially causing damage to existing waste management systems. Another potential option for Dominica would be the construction of an anaerobic digestion system that could biodegrade industrially compostable plastics, which could be beneficial in managing waste, contributing biogas back into the energy grid, and generating fertilizer byproducts.

Efforts for standard backyard composting have started to take hold in some areas of Dominica, particularly through the Kalinago Zero Waste pilot. Some hotels and tourism operations have reportedly made attempts to compost food waste, but not at scale. Interviewees noted the importance of regular collection and proper containers for this type of waste, as the tropical climate can rapidly attract pests and cause odor. These are factors that should be taken into consideration if backyard composting is scaled across the island.

End of Cycle: Zero-Waste Pilot

In 2022, DSWMC, in collaboration with OECS and the Norwegian Ministry of Foreign Affairs, started a flagship Zero Waste pilot project with the Kalinago indigenous community in the northwestern portion of Dominica. An initial Situational Analysis was conducted to assess the state of waste management and provide recommendations for fostering a zero-waste system. These recommendations included expanding upon and institutionalizing source separation of waste, creating collection infrastructure to avoid littering via stray dogs and other animals, and streamlining compostable refuse to increase quality and quantity (EnviroPlus 2022).

The goal of the pilot project was to create a system to enable proper waste sorting and processing and to simultaneously provide jobs and livelihood support to the indigenous Kalinago population. The intention was to provide every household in the territory with a residential garbage bin, a blue bin for recycling, and a 5-gallon bin for composting. Collection trucks originally came once per week to collect the household bins, but several months into the pilot the trucks were reduced to coming every two weeks because there was significantly less general garbage to collect. Another goal is to use compost for agriculture so that it can be profitable. This is something that has long been practiced among the Kalinago, such as using grass cuttings from NEP cleanups for organic farming. Interviewees also noted that the Kalinago have been using the local Calabash plant to create bowls and baskets and that the community is moving towards reusing and repurposing wherever possible.

> *"In the past, when the Kalinago went to Roseau, they would come back with plastic [shopping] bags. Now they are trying to use reusable bags … The Zero Waste Initiative is making reusable fabric bags out of jeans and other clothing." - Community leader*

These efforts have been coupled with strong education and outreach around how to use the new infrastructure, the value of sorting at source, and the benefits of a zero-waste system both environmentally and economically. Interviewees attributed the success of the pilot project to its bottom-up nature and the thought and planning that took place upfront, including data collection through the situational analysis, many community meetings, and outreach and education. As one

interviewee described it, the process was not forced onto the community, and instead, they let the community decide how they wanted the project to take place.

In the long term, DSWMC is hoping to have an organic waste and composting plant in the Kalinago territory. They are working closely with the Kalinago Council on drafting a design for the plant and its location. DSWMC hopes to create two additional regional organic composting plants across the island, as organic waste comprises around 40% of municipal solid waste in Dominica and around 64% of household waste in the Kalinago territory (EnviroPlus 2022; Seureca Veolia & Unite Caribbean, 2023). To date, the pilot has had many successes in diverting waste from landfill, and the hope is to expand upon and replicate this pilot initiative in coming years.

End of Cycle: Tourism and Business

Tourism and local businesses have an important role to play in solid waste management in Dominica. The Tourism Ministry of Dominica indicated in a press release that as of April 2023, Dominica received 190 cruise calls and 236,288 passengers for the 2022-2023 cruise season, representing a roughly 30% increase from the 2019-2020 season and the beginning of the COVID-19 pandemic. The ministry projected an additional 15-20% increase in cruise calls and passenger numbers for the 2023-2024 cruise season (Dominica News Online 2023). In addition to daily cruise passengers, the number of stayover visitors to the island exceeded 60,000 in 2022, representing an over 300% increase from 2021 and nearly approaching pre-pandemic numbers (Dominica Update 2023). While still lower than other popular Caribbean destinations, tourism in Dominica is certainly growing and now is a critical time to ensure that practices and policies remain sustainable for the local environment and economy.

According to interviewees, cruise ships are given the option to deposit their solid waste on Dominica when they come into port and they are permitted to leave plastic, glass, aluminum, and cardboard that is already processed and baled. Cruise ships are not currently permitted to deposit organic waste. Hotels often have their own waste management systems. DSWMC has reached out to hotels on the island to attempt recycling separation and processing, particularly PET bottles, but that has not happened at scale yet. Many of the higher-end hotels on the island were able to afford to switch to compostable plastic for to-go ware when the import ban went into place; however, those items are still destined for the landfill as industrial composting does not currently take place at hotels. Some hotels are also moving towards lower waste options such as refillable shampoo bottles and water refill stations, but this is not universal.

Anecdotally, several interviewees felt that the general litter found on the island comes largely from residents and not from tourists or visitors, but the sheer number of visitors can put a burden

on an already near-capacity waste management system. There are key opportunities to collaborate with this sector to ensure it is contributing to circular and zero-waste systems on the island and not providing additional challenges or barriers. Messaging and practices among tourism operators could also be streamlined and mandated. Many tourism operators already provide water refill options to their guests, low-waste snacks such as fruit, and other options to minimize their impact, and there may be opportunities to expand upon those actions and make them mandatory through permitting or otherwise. With respect to the cruise ship sector, it may also be worth exploring whether cruise ships that typically deposit waste on the island could transport recyclables or other waste either back to their main ports in the United States where there is enhanced solid waste management infrastructure or to other islands that have facilities to handle those materials based on a regional economy of scale.

As is the case with many solid waste operations worldwide, DSWMC often struggles with not having enough funding to complete all of the work that the department wants and needs to do. Some portion of the visitor levy is currently allocated to DSWMC to supplement their annual budget, which interviewees noted has comprised around 30-40% of the total budget when fully operational. However, hurricanes and the COVID-19 pandemic in recent years heavily limited that influx of funds. As tourism begins to rebound, it will be important for the Customs Department, the Treasury Department, and DSWMC to work closely to ensure those funds are allocated as intended. DSWMC also receives a small amount of funding directly from IATA for flights that come into the island, which could potentially also be revisited as tourism rebounds. There may be other creative solutions to supplement those funds, such as additional zero-waste, circular economy, or sustainability taxes for incoming visitors or tourism operators such as cruise lines. The funds that private companies pay for importing goods as part of the Environmental Tax in Dominica could also be allocated towards waste management and circularity initiatives. In general, local businesses should be engaged in conversations with DSWMC about the Global Plastics Agreement, goals, implications, and opportunities to ensure alignment moving forward.

End of Cycle: Disaster Preparedness

Waste management is intrinsically linked to Dominica's efforts to become a climate-resilient island and to enhance disaster preparedness. When a major hurricane hits Dominica, the cleanup of debris and waste is largely the responsibility of the Public Works department and now DSWMC, but the DSWMC landfill is often used as a holding location for the collected items. Interviewees mentioned that Hurricane Maria demonstrated the need for a dedicated landfill for hurricane and other natural disaster cleanup. The landfill is already nearing capacity, and the input from the hurricane was reportedly too much for the island to handle. In addition, littering and mismanaged waste can exacerbate flooding and decrease the effectiveness of stormwater management and drainage systems that the island is continuously developing. It would be

beneficial for waste management to be taken into consideration for any further disaster relief and climate resilience planning in Dominica.

Leakage

To better understand the quantities, types, and sources of litter in Dominica, systematic litter surveys were conducted for different environments and contexts across the island. This included land-based surveys, coastal beach surveys along the west coast of the island, nearshore floating debris surveys, and microplastic surveys from ocean samples around the island. Dominica has a Litter Act that was put in place in 1990 and further amended in 1997 (UNEP LEAP 2024), which includes language around fines for littering, though interviewees noted that the law is not well enforced and that fine quantities may need to be adjusted. As an island nation with 365 rivers, is it critical for Dominica to enact litter prevention measures throughout the island to prevent waste from ultimately entering the ocean, particularly during major rain events.

Leakage: Land-Based Litter

In total, 4,023 items were logged in 50 land-based transects (each approximately 100m^2) characterizing 4.36 square kilometers across the island (Figure 45). Transect locations were selected using a stratified random sampling method, in which transects were randomly selected in ten square kilometers which were distributed across three groups of population count (upper, middle, lower) based on LandScan ambient population data. Litter items were recorded using the open-source Marine Debris Tracker app. A full list of items available in the app and their associated material categories can be found in the Appendix (Table A1).

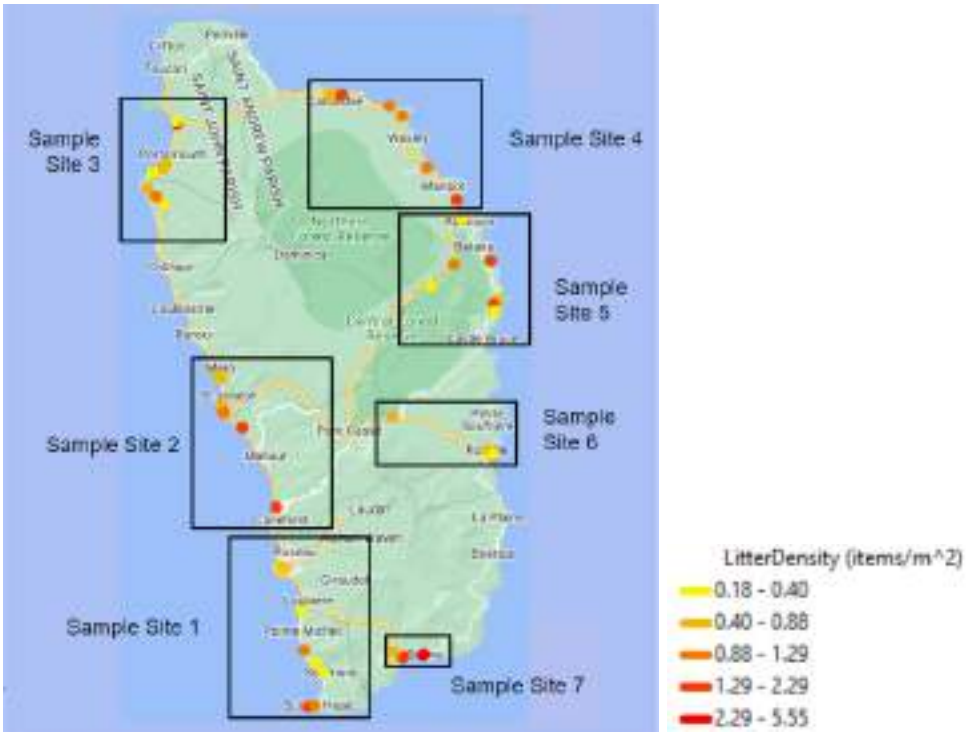

Figure 45: Average litter densities observed across sample sites in Dominica

The vast majority of littered items surveyed were plastic items (~70% of all items). The most common material type of land-based litter surveyed was food plastic (41% of items), followed by plastic fragments, metal, glass, and paper. Other material types, such as tobacco products and other plastics, comprised less than 5% of litter items respectively (Figure 46). Popular common plastic items (including food plastic, plastic fragments, PPE, personal care items, and other plastic) comprised 63% of all litter items surveyed. This is higher than other similar locations, such as 55% observed in Miami, 39% in Aruba, 48% in Hilo, and 37% in the Maldives.

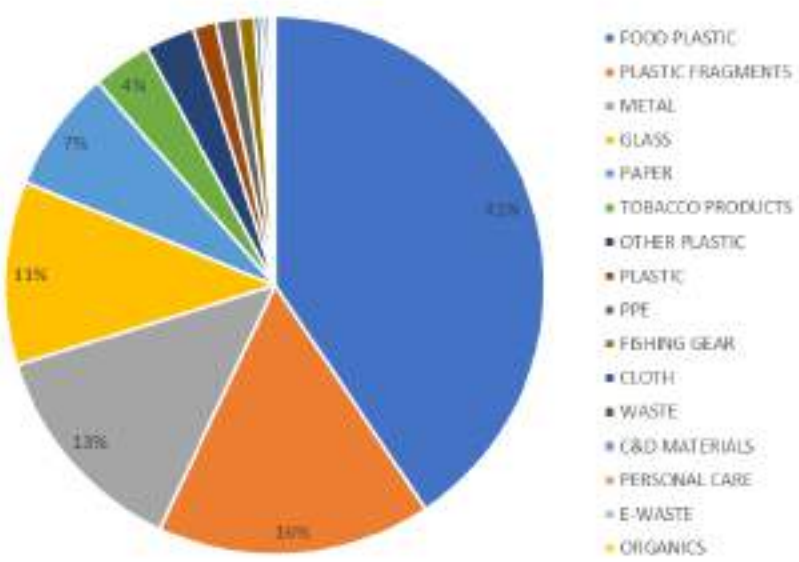

Figure 46: Material Breakdown for Land-Based Litter in Dominica

Across all land-based litter surveys, the top five most common items were 1) hard plastic fragments, 2) plastic food wrappers, 3) plastic bottles, 4) plastic bottle caps, and 5) metal bottle caps or tabs. However, it is worth noting the high abundance of hard plastic fragments that were found at Site 6, on Rosalie Beach on the east coast, which may have skewed the data (Figure 47). This Site had the highest litter density among the land-based sites and over 50% of the litter observed there was hard plastic fragments. The high density of small, brittle, hard plastic fragments along the windward and Atlantic side of the island is likely indicative of marine debris and litter that originated elsewhere and was transported to the coast, as has been observed in other parts of the Caribbean (Courtene-Jones et al., 2021).

Figure 47: Density of hard plastic fragments found at Site 6 on Rosalie Beach

If the data from Site 6 is removed, then plastic fragments become the third most abundant material type overall instead of the most abundant, and the top five most common litter items become: 1) plastic food wrappers (12% of items), 2) plastic bottles (11% of items), 3) hard plastic fragments (9% of items), 4) plastic bottle caps (8% of items), 5) metal bottle caps or tabs (7% of items) (Figure 48). Importantly, many of those top items, particularly plastic bottles and caps, are readily recyclable. Other non-recyclable litter items, such as plastic films from small bags of candy and ice pops, should be targeted for redesign, reuse, or collection to reduce instances of litter.

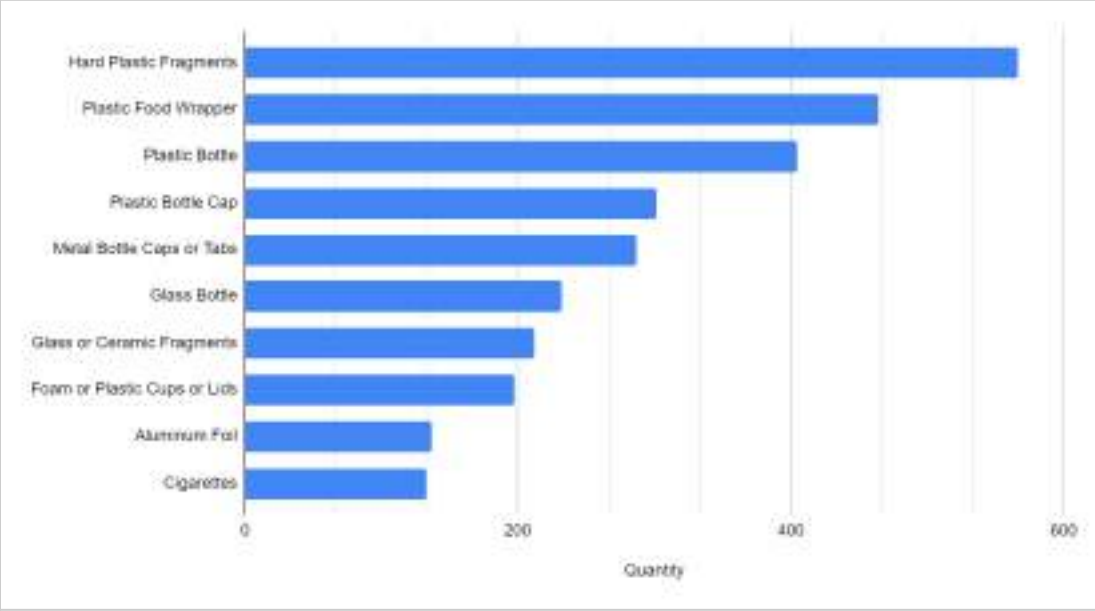

Figure 48: Quantity of the top ten litter items observed in Dominica

Other scientific studies have shown that common marine litter items in Latin America and the Caribbean (LAC) include plastic bottles, plastic food packaging, and abandoned, lost, or otherwise discarded fishing gear (ALDFG), and land-based litter items are dominated by tobacco products, plastic fragments, and food plastic, specifically plastic bottles, cigarette butts, and plastic bottle caps (Diez et al., 2019; Brooks et al., 2020; Courtene-Jones et al., 2021). Dominica follows a similar trend, but there was a lower abundance of tobacco products and a higher quantity of recyclable items such as plastic bottles found in the litter surveys.

Other island locations, such as Hawaii and Aruba, have established bans on SUP grocery bags and on foam to-go ware products. Aruba is implementing bans on additional SUP products as part of their Plastic Ordinance, such as cups, straws, and stirrers. There is a higher density of littered plastic grocery bags observed in Dominica and other locations without existing policies such as the Maldives when compared to locations with plastic bag bans (Table 9). The Maldives, however, is planning a plastic bag policy for 2025. The density of plastic bottles in Dominica is

comparable to that of Aruba, though lower than the Maldives and higher than Hilo, Hawaii. This could be due to differences in access to curbside recycling and PET recycling markets on-island. Dominica has a comparatively low density of plastic and foam container litter, which could be in part due to the transition towards fiber and biodegradable food containers as part of their SUP policy. However, Dominica has a comparatively high density of plastic cups and lids, which could represent the compostable alternatives such as PLA that were often found in the store and restaurant surveys. Precautions and policies should be put in place to ensure that those items still do not end up littered in the environment, as they will not break down naturally and could still pose a threat to the natural environment, flooding risks, and human health.

Table 9: Comparative litter densities in island contexts

Item	Average items per transect in Maldives (items/100 m^2)	Average items per transect in Hilo, HI (items/100 m^2)	Average items per transect in Aruba (items/100 m^2)	Average items per transect in Dominica (items/100 m^2)
Plastic grocery bags	4.48	0.03	0.67	1.42
Plastic and foam cups or lids	1.78	0.42	1.71	3.94
Plastic utensils	1.81	0.22	0.85	0.90
Straws	1.07	0.19	1.63	0.34
Plastic and foam containers	1.85	0.33	0.22	0.16
Plastic beverage bottles	17.26	0.44	8.74	8.08

Importantly, litter was also often co-located with storm drains, canals, open dumping areas, or other natural areas of accumulation for litter and waste (Figure 49). This can pose a challenge to infrastructure and resilience and can also be difficult to clean in certain locations, such as cliff-side dumping spots.

Figure 49: Example litter photos from canals (left), open areas (right), and along cliff sides (right)

When compared across ambient population density, differences can be observed in the most common material types for litter (Figure 50). For example, lower ambient population areas had the highest proportion of food plastic items, whereas middle ambient population areas had the highest proportion of plastic fragments. Relatively similar proportions were observed for non-plastic litter items such as glass and paper. These differences could suggest discrepancies in access to waste management, messaging and outreach, or collection infrastructure available in those locations.

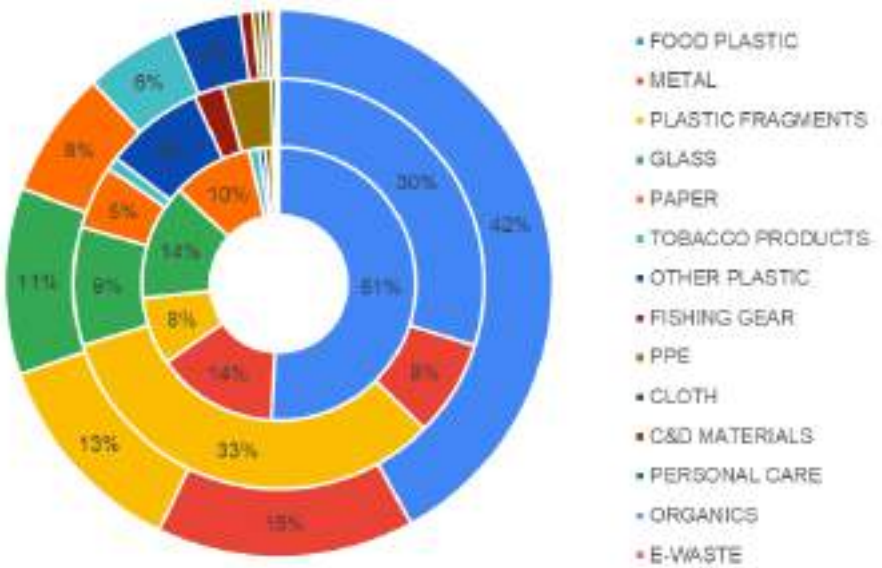

Figure 50: Proportion of most common plastic items in low (inner), mid (middle), and high (outer) population count areas in Dominica

Different material types can also be observed based on physical geography (Figure 51). For example, food plastic was the most common litter item by material type on average in all sampling locations except for Site 6 near Rosalie Beach. Fishing gear and miscellaneous plastic

items were more often found in fishing communities, such as Stowe in the south. Metal items were also often found in areas with higher societal activity, such as car parts and metal fragments in residential and busy areas. Tobacco products were also more readily found in areas such as Roseau where there were more people during the day and more activity in the evenings. Understanding the most problematic litter items in different locations can help target interventions and messaging to prevent those items from entering the environment.

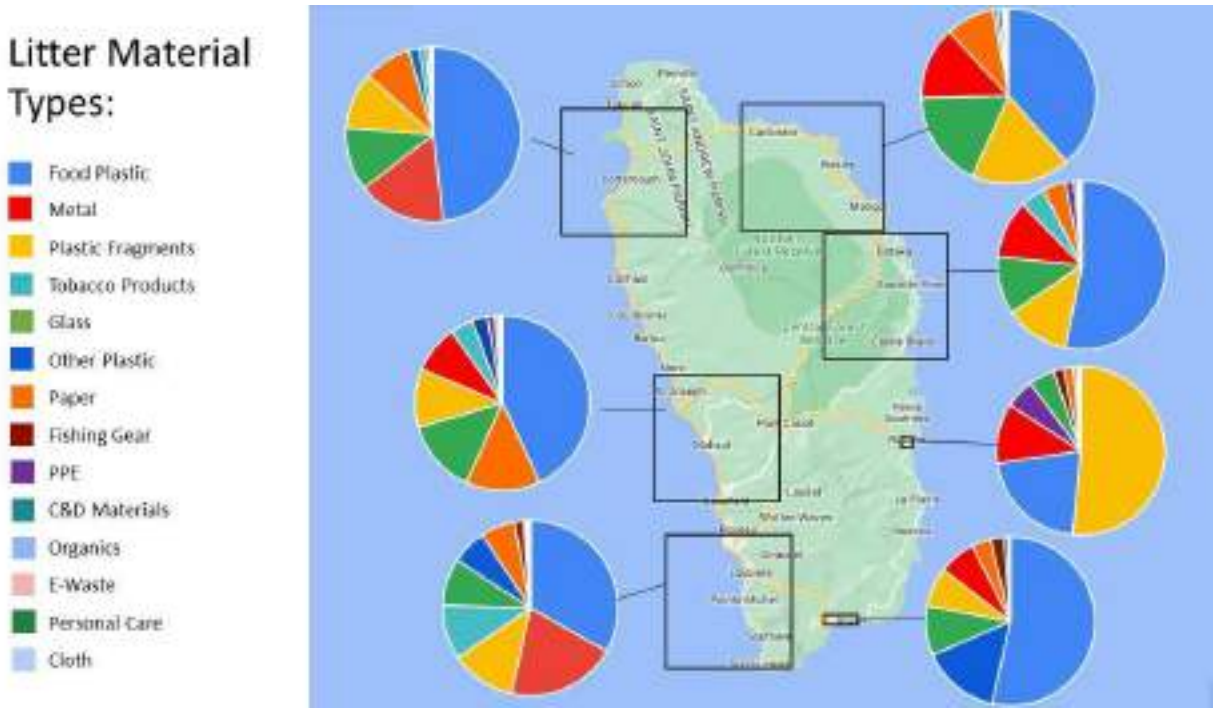

Figure 51: Litter material types observed by sample site

Litter density can also be observed based on ambient population density (Table 10). In Dominica, the highest average litter density was observed in areas with middle ambient population, followed by areas of high ambient population, and the lowest litter density was observed in areas of low ambient population. This could be a positive indication that more rural areas still have access to waste collection and are using those services, or it could be a matter of less litter in areas where people often do not visit or live in the inner parts of the island. Average land-based litter density in Dominica, at around 0.92 litter items/m^2, is relatively similar or low compared to other locations, such as 2.52 items/m^2 in Aruba, 2.58 items/m^2 in Miami, 1.12 items/m^2 in the Florida Keys, 2.92 items/m^2 in the Maldives, and 0.27 items/m^2 in Hilo.

Table 10: Litter Density and Top Litter Items for Each Area of Population Count

Population Tertile	Top 5 Litter Items	Litter Density (count/m2)
High (n=29) 94 - 6,885 people/km^2	1) Plastic Food Wrapper 2) Hard Plastic Fragments 3) Plastic Bottle 4) Metal Bottle Caps or Tabs 5) Plastic Bottle Cap	0.95 items/m^2
Medium (n=10) 25 - 94 people/km^2	1) Hard Plastic Fragments 2) Plastic Bottle Cap 3) Plastic Bottle 4) Glass or Ceramic Fragments 5) Bottle or Container Caps	2.04 items/m^2
Low (n=11) 1-25 people/km^2	1) Plastic Food Wrapper 2) Plastic Bottle 3) Glass Bottle 4) Aluminum Foil 5) Plastic Bottle Cap	0.77 items/m^2

Differences in land-based litter density, common materials, and common items can also be seen across physical geographies (Table 11). Observed litter densities were on average highest at Site 6, where a large quantity of hard plastic fragments was found on the windward and Atlantic side of the island. Litter densities were also high at Site 7 in the south and Site 4 in the northeast. The lowest litter density was observed at Site 1 in the southwest. Hard plastic fragments and food wrappers were among the top five most common litter items in all geographic areas. Most also had a high amount of plastic bottle caps, metal bottle caps or tabs, and plastic bottles. Plastic bottles were the most common litter item found at Site 3 in the northwest and at Site 7 in the south.

Table 11: Top Litter Material Types, Items, and Density for Land-Based Surveys in Dominica

Sample Site Area	Top 3 Litter Materials	Top 5 Litter Items	Average Litter Density
Site 1 (n=12)	1) Food Plastic, 2) Metal, 3) Plastic Fragments	1) Metal Bottle Caps or Tabs, 2) Hard Plastic Fragments, 3) Cigarettes, 4) Plastic Food Wrapper, 5) Plastic Bottle Cap	0.65 items/m^2
Site 2 (n=7)	1) Food Plastic, 2) Paper, 3) Glass	1) Plastic Food Wrapper, 2) Plastic Bottle, 3) Hard Plastic Fragments, 4) Glass Bottle, 5) Other Paper	1.07 items/m^2
Site 3 (n=8)	1) Food Plastic, 2) Metal, 3) Glass	1) Plastic Bottle, 2) Plastic Food Wrapper, 3) Plastic Bottle Cap, 4) Hard Plastic Fragments, 5) Foam or Plastic Cups or Lids	0.87 items/m^2
Site 4 (n=7)	1) Food Plastic, 2) Plastic Fragments, 3) Glass	1) Plastic Food Wrapper, 2) Hard Plastic Fragments, 3) Glass or Ceramic Fragments, 4) Glass Bottle, 5) Plastic Bottle	1.18 items/m^2
Site 5 (n=7)	1) Food Plastic, 2) Plastic Fragments, 3) Metal	1) Plastic Food Wrapper, 2) Hard Plastic Fragments, 3) Plastic Bottle, 4) Glass Bottle, 5) Metal Bottle Caps or Tabs	0.93 items/m^2
Site 6 (n=6)	1) Plastic Fragments, 2) Food Plastic, 3) Metal	1) Hard Plastic Fragments, 2) Plastic Food Wrapper, 3) Plastic Bottle Cap, 4) Hair nets, 5) Aluminum Foil	2.24 items/m^2
Site 7 (n=3)	1) Food Plastic, 2) Other Plastic, 3) Glass	1) Plastic Bottle, 2) Plastic Bottle Cap, 3) Bottle or Container Caps, 4) Plastic Food Wrapper, 5) Foam or Plastic Cups or Lids	1.92 items/m^2

For some litter items, the team was able to also identify the brands present (Figure 52). For plastic cups, the most common brand identified was from KFC fast food, most commonly plastic-lined paper cups, and around 40% of all plastic cups identified in the litter surveys were made of PLA, a compostable plastic that required industrial composting. Among plastic bottles, the most common brands identified were Trois Pitons, Coca-Cola, Busta, Sprite, and Quenchi -

over half of which come from a domestic distributor. The most common brands identified among glass bottle litter were Carib, Kubuli, and Heineken, which may highlight opportunities to improve upon or expand glass bottle return programs. Anecdotally, interviewees felt they saw less glass bottle litter from local brands that offered return/deposit after that program went into place. Among plastic food wrappers, which was the second most common litter item found across all land-based surveys, the most popular brands identified were Candy Mints, Holiday chips, chewing gum, Bermudez, and Xtime. Several of those brands are also manufactured and distributed within the Caribbean and may present opportunities for regional extended producer responsibility and product redesign.

Figure 52: Examples of top brands found in litter items

Dominica has a National Employment Program (NAP) that assists in roadway cleanups across the island. There is a group of NEP workers in each community who are hired by the government to clean roadways twice a month. They have set collection days for litter that they collect with DSWMC to ensure it is properly disposed of. From anecdotal observation, it is clear that areas with a strong NEP presence have less litter and are overall well-maintained and clean (Figure 53). This is a strong and effective program that should be continued and supported throughout Dominica.

Figure 53: Examples of roadside areas maintained by NEP

Leakage: West Coast Beach Litter

In addition to the randomized land-based litter sampling, ten coastal and beach areas along the west coast of Dominica were selected for litter surveys. These were selected based on locations where DSWMC had previously conducted litter surveys and was planning to do ongoing research (Figure 54). In total, 1,692 litter items were logged across the ten coastal sites, covering a roughly 1,200m^2 area. The average litter density observed in these areas was 1.36 items/m^2, which is slightly higher than the land-based litter densities observed. Over half of these sampling locations were associated with a storm drain, canal output, or informal open dumping site.

Figure 54: Coastline and Beach Litter Sampling Locations in Dominica

The material breakdown of coastal litter items was similar to that of the land-based survey, with the highest proportions of litter being plastic fragments (44%) and food plastic (30%) (Figure 55). These two categories comprised nearly ¾ of all litter surveyed along the coast. Glass was observed at a slightly lower percentage, but metal and paper items were observed less on average in coastal locations compared to land-based surveys. Not surprisingly, fishing gear comprised a higher proportion of waste found on coastal surveys than land-based surveys.

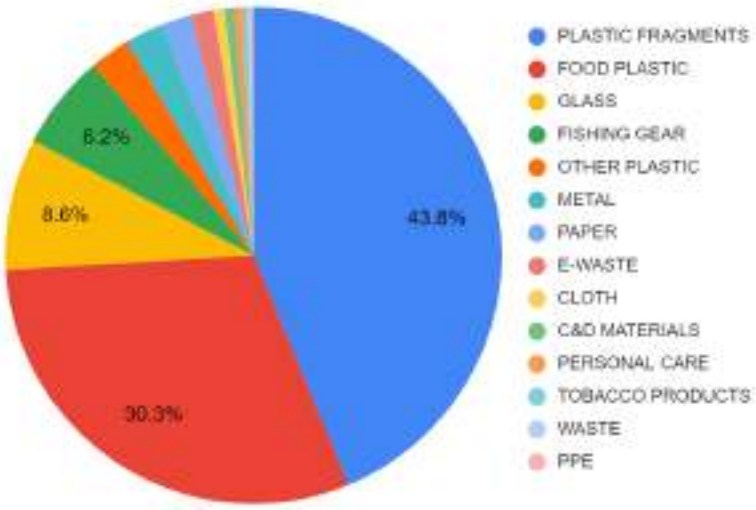

Figure 55: Material Breakdown for Coastline and Beach Litter in Dominica

The top ten most common litter items found in the coastal litter surveys included: 1) hard plastic fragments, 2) foam fragments, 3) plastic bottles, 4) glass or ceramic fragments, 5) plastic bottle caps, 6) other fishing gear, 7) film fragments, 8) plastic food wrappers, 9) plastic string/tape/or packing straps, and 10) plastic utensils (Figure 56). It is worth noting that some of the plastic utensils identified may have been compostable plastic, but it is difficult to make the distinction when the item has been in the environment and is not well marked.

Figure 56: Example of beach litter on the west coast of Dominica near a storm drain outlet (left) and resulting from dislodged trash bins (right)

Geographical differences were observed in litter materials, items, and densities across the coastal survey locations (Table 12). The highest litter density was observed at Boy Boy Beach, which had a higher litter density than any of the land-based litter transects. Observed litter densities were also higher than that of the land-based litter transects at Donkey Beach, Rockaway Beach, Soufriere Beach, and both the Caribbean and Atlantic sides of Scotts Head Beach. The lowest

litter density was observed at Champagne Beach, which is an area that is relatively maintained and regularly cleaned as it is a popular spot for tourism. All types of plastic fragments were found across the sample sites and plastic bottles remained a common litter item.

Table 12: Top Litter Material Types, Items, and Density for Coastal and Beach Surveys in Dominica

Transect Area	Top 3 Litter Materials	Top 5 Litter Items	Average Litter Density
Belle Hall Beach	1) Plastic Fragments, 2) Glass, 3) Tobacco Products	1) Hard Plastic Fragments, 2) Paper Cups, 3) Glass or Ceramic Fragments, 4) Cigarettes, 5) Glass Bottles	0.28 items/m^2
Purple Turtle Beach	1) Food Plastic, 2) Plastic Fragments, 3) Glass	1) Glass or Ceramic Fragments, 2) Hard Plastic Fragments, 3) Compostable plastic container or clamshell, 4) Compostable cups, 5) Plastic Bottle Cap	0.55 items/m^2
Mero Beach	1) Plastic Fragments, 2) Food Plastic, 3) Metal	1) Hard Plastic Fragments, 2) Plastic Utensils, 3) Plastic Bottle Cap, 4) Film Fragments, 5) Plastic Bottle	0.89 items/m^2
Donkey Beach	1) Plastic Fragments, 2) Food Plastic, 3) Paper	1) Foam Fragments, 2) Hard Plastic Fragments, 3) Plastic Bottle, 4) Plastic Bottle Cap, 5) Plastic Food Wrapper	1.87 items/m^2
Rockaway Beach	1) Plastic Fragments, 2) Food Plastic, 3) Paper	1) Foam Fragments, 2) Plastic Bottle, 3) Hard Plastic Fragments, 4) Film Fragments, 5) Paper fragments	1.59 items/m^2
Boy Boy Beach	1) Plastic Fragments, 2) Food Plastic, 3) Glass	1) Plastic Bottle, 2) Foam Fragments, 3) Hard Plastic Fragments, 4) Film Fragments, 5) Plastic Bottle Cap	3.57 items/m^2
Champagne Beach	1) Plastic Fragments, 2) Food Plastic, 3) Paper	1) Hard Plastic Fragments, 2) Foam Fragments, 3) Plastic Bottle, 4) Compostable plastic container or clamshell, 5) Film Fragments	0.19 items/m^2

Soufriere Beach	1) Glass, 2) Plastic Fragments, 3) Food Plastic	1) Glass or Ceramic Fragments, 2) Hard Plastic Fragments, 3) Plastic Food Wrapper, 4) Plastic String/ Tape/ or Packing Straps, 5) Plastic Bottle	1.91 items/m^2
Scotts Head Beach (Caribbean)	1) Plastic Fragments, 2) Food Plastic, 3) Fishing Gear	1) Hard Plastic Fragments, 2) Plastic Bottle Cap, 3) Foam Fragments, 4) Film Fragments, 5) Fishing Line	1.49 items/m^2
Scotts Head Beach (Atlantic)	1) Food Plastic, 2) Plastic Fragments, 3) E-Waste	1) Hard Plastic Fragments, 2) Plastic Bottle, 3) Plastic Bottle Cap, 4) Film Fragments, 5) Plastic Grocery Bag	1.22 items/m^2

Anecdotally, several interviewees mentioned that they believed most of the coastal litter in Dominica originated from land-based sources and was not from human activity taking place on the beaches themselves. In some locations, such as Purple Turtle, Mero, and Champagne beaches, the higher presence of compostable foodware may be indicative of direct dumping from patrons of local food vendors or people that are bringing food to the beach for recreation. As noted earlier, most of those compostable items, particularly the compostable plastic, will not break down naturally in the environment and will behave similarly to standard fossil-based plastic if not properly disposed of. Most of the beaches, however, did demonstrate an abundance of items such as food wrappers and bottles that appeared to have been transported there by nearby storm drains or waterways. Any item of litter that ends up in a coastal area is likely to end up in the ocean, and interventions should be focused on mitigating key sources such as drains, canals, rivers, and local recreation.

Leakage: Nearshore Ocean Litter

A 20 km stretch of nearshore area was also sampled for floating litter via boat (Figure 57). In total, 125 litter items were logged. There were intrinsic challenges associated with this type of sampling due to visual reach, rough seas, and the inability to see subsurface or bobbing litter, and data should not be considered an exhaustive sampling of litter in this area.

Figure 57: Nearshore Litter Sampling Locations in Dominica

Floating bottles were among the top items identified in the nearshore litter survey; however, it was not always clear which were used as markers or flotation for fishing gear and were intended to be semi-permanent as opposed to those that were floating as litter (Figure 58). DSWMC has collaborated in the past with fishermen on waste management, but it would be beneficial for a more formal relationship or set of messaging to be developed around best practices for the disposal of fishing gear, particularly nets, traps, oil, and empty ice bags.

Figure 58: Example of floating nearshore marine litter in Dominica

All of the floating litter that was identified in the nearshore surveys was either fishing gear (~70% of items) or food plastic (~30% of items), by material type (Figure 59). The top five most

common litter items observed were other fishing gear (largely floating bottle markers for fish traps), plastic bottles, plastic bottle caps, plastic food wrappers, and plastic grocery bags.

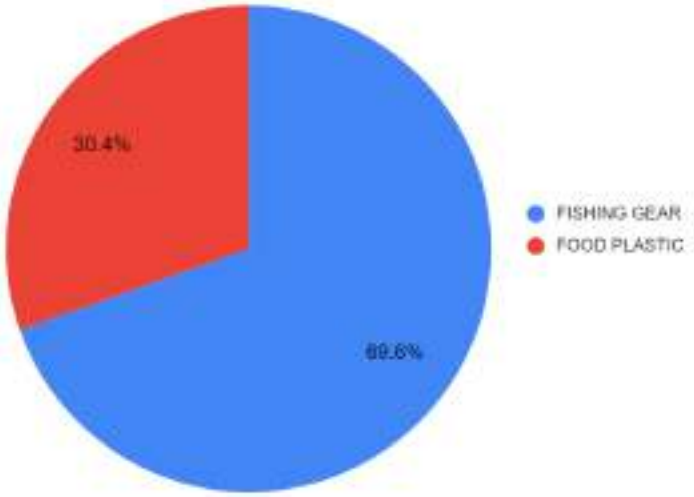

Figure 59: Material Breakdown for Offshore Litter in Dominica

It was evident in the nearshore survey that drainage from canals and storm drains, open dumping immediately along the coast, and output from freshwater streams and rivers contributed heavily to the litter that was entering the marine environment around Dominica (Figure 60).

Figure 60: Sources of floating macroplastic and litter entering the nearshore marine environment - storm drains (left), coastal open dumping (middle), and freshwater streams and rivers (right)

Different solutions may be appropriate in the context of coastal litter and nearshore marine debris in Dominica. These may include storm drain nets, river booms, or other interception devices. A

river boom was attempted during fieldwork in Dominica in Canefield using a 10-ft plastic bottle boom from Elastec (Figure 61). The boom was able to trap a fiber food container, a plastic glove, a paper cup from KFC, two plastic bottles, and three food wrappers over the course of five days, but the flow of the river was very heavy and it is estimated that not all floating litter items were effectively trapped.

Figure 61: River boom that was piloted in Canefield in April 2023

It may be useful to explore something more permanent and sturdier that could perhaps be maintained by local school groups, youth groups, or otherwise. It is clear that the hydrology of the island plays a key role in contributing to marine litter and the many rivers, streams, and drain outlets across the island should be prioritized for interventions. This is also critical to Dominica's endeavor for climate resilience, as eliminating waste along drains and canals can alleviate flooding and reduce risks during major weather events.

The west coast of Dominica is also a critical habitat for the local population of sperm whales. While individuals are known to move between Dominica, Martinique, and Guadeloupe, over half of the individuals from that regional unit are regularly identified on the leeward side of Dominica and there is a large resident population (Rinaldi et al., 2020). Many studies recognize that this population has been in decline in recent years - in part due to increased occurrences of water pollution, entanglement in fishing gear, and ingestion of marine debris - with estimated annual decline rates of 4.5% - 6.2%. (Gero et al., 2016; Rinaldi et al., 2020; Vachon et al., 2020). The Dominica Sperm Whale Project and Project CETI are among the groups that have been monitoring this population. Dominica remains a tourism hub for vessel-based whale watching in the Lesser Antilles and was one of the first and only islands to also offer swim-with-whale opportunities for tourists. As such, sperm whales contribute heavily to the local economy through tourism and play a key role in the local marine ecosystem, but these same activities need to be regulated to minimize the impact on the whales themselves and their habitat. It is important

to ensure that steps are taken to minimize local impacts on sperm whales, particularly through mitigating marine debris and other point-source pollution, to protect this unique population for generations to come.

It has been well-documented that plastic fishing line, plastic bags, and other plastic marine debris pose a serious threat to sperm whales and other marine megafauna. Sperm whales are among several cetacean species worldwide that have been readily observed actively interacting with plastic marine debris (Rodriguez et al., 2023). One popular story in 2019 documented a baby sperm whale named Digit off Dominica that had fishing line entangled in his fluke for three years (Welch, 2019). Necropsies worldwide have shown cases of gastric rupture, starvation from gastric blockage, and physical entanglement as causes of death for sperm whales. This is not only caused by common marine debris such as plastic bags and fishing line, but examples have also found pieces of candy wrappers, clothing hangers, bottles, mattresses, appliances, rope, coffee capsules, pipe, and other land-based and household plastic items in the stomachs of stranded sperm whales (Jacobsen et al., 2010; de Stephanis et al., 2013; Unger et al., 2016; Tonay et al., 2021). Studies have also suggested that these items were ingested by sperm whales at the surface as debris, instead of perhaps bitten off from operational or active fishing gear in the water column (Jacobsen et al., 2010). Understanding the sources of these fatal types of marine debris is critical for upstream prevention to ensure that these items are not entering the terrestrial environment, and ultimately reaching the ocean, in the first place.

Leakage: Offshore Microplastics

As part of the National Geographic Pristine Seas expedition to Dominica in 2022, water samples were collected from surface water and analyzed for microplastic concentrations and characteristics (Figure 62). Grab samples of water were collected from the surface layer using 1,183 mL stainless steel bottles, which were triple-rinsed with seawater near the collection site prior to collection. The water samples were filtered through cellulose acetate filters with a 10-micron pore size, and the filters were stored in aluminum pans covered in aluminum foil. Precautions were taken by researchers to avoid contamination of microplastics both onboard for the filtration and for the analysis for microplastics conducted. A random selection of 11 of 28 sample filters were then analyzed with spectrum microscopy methods for the presence of microplastic particles. Samples were opened and analyzed in a class 10,000 clean room at the New Materials Institute at the University of Georgia. A high-throughput Raman microscope was used to survey the spectrum of many thousands of microparticles down to about 30 μm (n = 8,304 spectra) and blank controls were used to evaluate microplastic concentrations from samples.

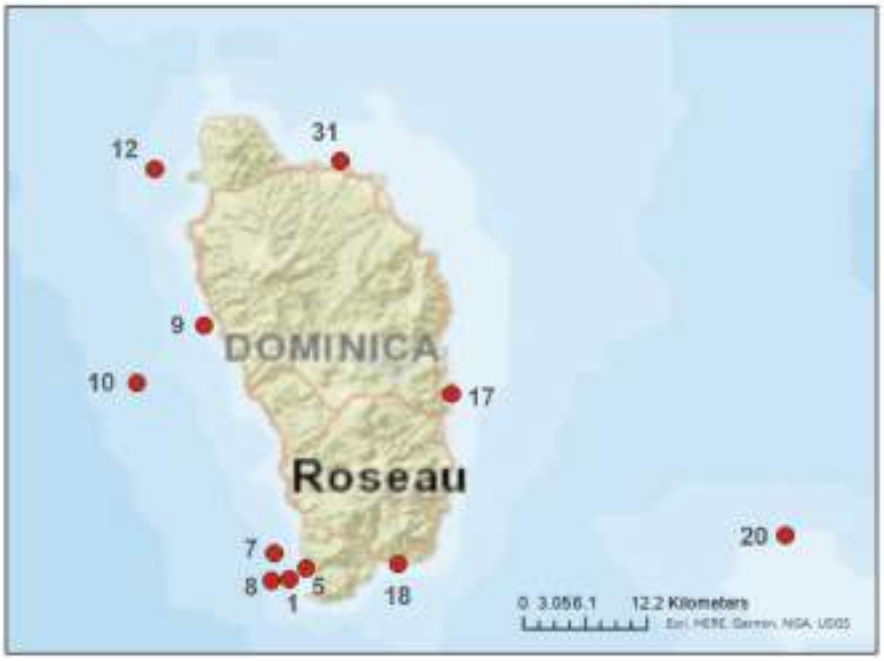

Figure 62: Locations of ocean microplastic sampling by the National Geographic Pristine Seas Team

Out of the 11 water samples that were randomly selected for analysis, five contained microplastics. A total of nine particles were detected across all samples analyzed. Polymers identified included PE, HDPE/LDPE, PS, and PET. The most common polymer identified from the surface water samples was PET.

While the quantities of microplastics appear low, they are significant due to the low volume of water sampled (Table 13). In 2021, a Caribbean-wide study of microplastics found an average of 1.17 microplastic particles per m^3 (or 1,000 L) of surface water sampled via manta trawling. Quantities ranged from zero microplastics detected in some locations in Aruba and Colombia to a maximum of 5.09 particles/m^3 detected in the San Blas Islands in Panama. Types of polymers also differed significantly between locations (Courtene-Jones et al., 2021). Comparatively, the highest quantity of microplastics observed in the Dominica surface water samples was 3 particles (from sample DMA_MP_08). As this was from a 1.18 L water sample, this would extrapolate to 2,535 particles/m^3, which is magnitudes higher than that observed in Courtene-Jones et al. However, further analysis using higher water concentrations and more comprehensive area coverage would be required to provide an accurate estimate of that extrapolated microplastic quantity.

Table 13: Microplastic quantities and characterization from surface ocean water samples in Dominica

Sample ID	PE	PP	PS	PET	PVC	HDPE / LDPE	Nylon-6,6
DMA_MP_01	0	0	0	1	0	0	0
DMA_MP_05	0	0	0	0	0	0	0
DMA_MP_07	0	0	0	0	0	0	0
DMA_MP_08	0	0	0	3	0	0	0
DMA_MP_09	0	0	1	0	0	1	0
DMA_MP_10	0	0	0	0	0	0	0
DMA_MP_12	0	0	0	0	0	0	0
DMA_MP_17	0	0	0	0	0	0	0
DMA_MP_18	0	0	1	0	0	0	0
DMA_MP_20	1	0	0	1	0	0	0
DMA_MP_31	0	0	0	0	0	0	0
Total Sample Microplastics	1	0	2	5	0	1	0

The fact that five of the nine found microplastic particles in Dominica were PET is also important to highlight. These smaller particles of PET appear to be fibrous fragments and are likely found at the surface waters due to their small size. Such PET fibers may have come from land-based sources (e.g., laundering of PET-based clothing), although a more comprehensive survey would be required to confirm the source of these microplastics. PET was also among the top littered items found in Dominica and the material, in the form of beverage bottles, is regularly used as a marker and flotation device for nearshore fishing gear, which would also contribute to marine PET microplastics (Figure 63). As PET has a density greater than that of sea water, coupled with the high quantity of PET found in litter surveys in Dominica, this may suggest that a higher concentration of PET microplastics could be found in subsurface waters or sediments in Dominica, as has been found on other locations in the Caribbean (Courtene-Jones et al., 2021). There are opportunities for further investigation and ongoing monitoring of these factors in Dominica through the local university, DSWMC, and the local Bureau of Standards.

Figure 63: Example of PET bottles used for fishing gear markers and buoys

The presence of microplastics in ocean water also raises concerns about concentrations in local fish species, particularly species that are regularly ingested by humans. Fish protein comprises a large proportion of the local diet in the Caribbean. Instances of food-borne diseases and toxins have been well documented in Caribbean fish species and remain a concern for local food sources (Tester et al., 2010; Hull-Jackson et al., 2019). Recent studies have also found microplastics in commercial fish species across the Caribbean, though impacts on human health among populations that depend on those species for food in the region is not as well documented (Aranda et al., 2022; Garcés-Ordóñez et al., 2022; Orona-Návar et al., 2022). Studies have, however, demonstrated clear linkages between microplastics and negative impacts on human health, such as occurrences of asthma, cancer, cardiovascular disease, pulmonary disease, decreased fertility, and others (Landrigan et al., 2023). Further research should be conducted to investigate the prevalence, characteristics, and sources of microplastics in the waters surrounding Dominica and the associated potential ecosystem and human health impacts.

Opportunities

CIL found the following opportunities to expand and enhance circularity in Dominica based on the findings of this report. These opportunities are categorized based on the seven spokes of the CAP model. Stakeholder engagement with the partners of this project could take place to further expand, refine, and prioritize these opportunities based on local context, impact, feasibility, and cost. It is important to note that the opportunities listed below are individualized based on the findings, but solutions cannot happen in a vacuum and are most impactful when strategically combined within a holistic system framework.

INPUT 	**Findings:** In total, 225 unique brands of convenience products were collected and sampled from 37 convenience stores across Dominica. Among all of the five convenience product categories (beverages, candy, chips, tobacco, and biscuits/wafers), each had at least one manufacturer that was located domestically in Dominica. The United States, Trinidad & Tobago, and Jamaica were among the top importing countries for convenience products. Across all product categories, Dominica-based operations represented around 6% of the market both among manufacturers and parent companies. Opportunities exist to enhance local manufacturing and business opportunities and to mobilize regional partnerships for extended producer responsibility (EPR), product redesign, and takeback schemes. **Opportunities:** ● Adjust Dominica's SUP import ban and policy to be based on the type of polymer or resin code instead of the product labeling to ensure non-biodegradable or non-compostable items are not being imported; support enforcement mechanisms and polymer testing infrastructure ● Target key importing countries for FMCGs, such as the United States, Trinidad & Tobago, and Jamaica, for potential extended producer responsibility or collaborative waste collection and recycling options, particularly for the most problematic plastic items such as films ● Explore opportunities to bottle local spring water, including revisiting infrastructure proposals from pre-Hurricane Marina, or increase production from local operations such as Trois Pitons to reduce bottled water importation from other parts of the Caribbean
COMMUNITY 	**Findings:** Semi-structured interviews were conducted with 28 key stakeholders, including local government officials, students from the local university, private companies (including tourism operators), community leaders, non-profit organizations, private store owners, and private restaurant owners. Interviewees expressed general support for the single-use plastic (SUP) ban in Dominica and for increased opportunities around recycling. There was a unanimous need to increase education, outreach, and consistent messaging to the public and to businesses around waste separation, particularly at key events (e.g., music and cultural festivals) and through existing popular channels (e.g., radio shows and social media). Interviewees expressed the importance of making changes affordable and convenient and stressed that messaging and incentives need to be able to reach all consumers, not only those who care strongly about the environment or nature. **Opportunities:** ● Strengthen existing solid waste and SUP policies and legislation within Dominica, including but not limited to Utility Fees and the Litter Act and associated fin structures - complement this with learning exchanges with other Caribbean nations that have implemented SUP bans, such as Saint Kitts & Nevis and Antigua & Barbuda ● DSWMC could host a formal national campaign around sorting household waste at source, taking learnings from the Kalinago Zero Waste pilot ● Bolster public education and awareness (including school programs, cleanups, regular radio shows, cultural events, billboards) particularly around littering and environmental preservation, with ties to messaging around protecting the Nature Island, and ensure this is extended to visitors and tourists ● Develop clear messaging around the disposal of compostable plastics that can be targeted for restaurants, the general public, and tourism operators/tourists ● Provide additional support, budget, and staff for marketing, education, and outreach around solid waste management through DSWMC

	• Consider hosting a Caribbean-wide convening to share SWM best practices, network across groups, and identify shared goals for INC; this could be conducted through OECS, CARICOM, or other existing networks • Incorporate data around ties to litter, pollution, and human health into public communication, potentially in collaboration with the Ministry of Health
PRODUCT DESIGN 	**Findings:** In addition to the 225 convenience items, 108 to-go foodware items were sampled from 40 restaurants and food vendors across Dominica. Convenience product packaging was dominated by multilayer plastic film and PET plastic bottles. The largest proportion of material for to-go foodware was PLA, an industrially compostable plastic, followed by fiber and non-coated paper, reflecting the influence of the SUP import ban. In addition, 9 large grocery stores across the island were surveyed for the material type of packaging of several key household items: Cooking Oil, Eggs, Greens, Laundry Detergent, Milk, Rice, and Sugar. Nearly 50% of all household items sampled were packaged in single-layer plastic bags, followed by those packaged in PET and HDPE. Difficult-to-recycle products such as plastic film could be targeted for product redesign, EPR, bulk/reuse options, or elimination, while recyclable items could be targeted for collection and effective end-markets. Compostable plastic also needs to be handled appropriately, as it will not break down naturally in the environment. **Opportunities:** • Consider an updated labeling process, particularly for different types of plastic items, to reduce confusion among consumers and reduce contamination of sorted waste streams - this includes guidance on the packaging related to disposal (e.g., chasing arrows symbol vs. recirculate symbol), which may also require regional discussions and collaborations with manufacturers and importers to ensure harmonization and consistency • Develop incentives and opportunities for expansion of local businesses in SUP alternatives, particularly for foodware, to reduce the reliance on imported goods to meet the needs of the SUP ban • As the most abundant material type among FMCGs, PET bottles and multilayer plastic film could be targeted for product redesign, reuse, or recycling opportunities • Capitalize on lessons learned from other Caribbean and island nations on product design and disposal innovation that has been successful
USE 	**Findings:** Among the 9 large grocery stores that were surveyed, 107 individual SUP and plastic alternative items were identified in the categories of sandwich bags, cups, food containers, plates, utensils, straws, and shopping bags. The most common single-use grocery bag distributed was black plastic labeled “biodegradable LDPE,” which is likely in fact oxo-degradable. Alternative (biodegradable, compostable, alternative material, reusable) household items were unanimously more expensive than single-use plastic options. Many of the alternative brands that were identifiable were imported from the United States, China, the United Kingdom, though there is also a market within Dominica that could be expanded upon. Several countries, including the United States and China, were also found to continue importing standard single-use plastic options. Opportunities exist to strengthen the SUP import ban and other policies and legislation to provide viable and affordable SUP alternatives, grow the local economy, decrease dependence on foreign imports, and increase waste diversion from landfill. Local efforts around the circular economy could also bolster jobs and skilled workers on-island. **Opportunities:** • Expand upon technology and social media rewards, similar to the WePlanet model, to encourage consumers to bring reusable items - this should be adopted

	and encouraged by local manufacturers, grocery stores, convenience stores, and food vendors • Foster business opportunities domestically around reuse models and alternative materials, as well as investment and local capital to support those initiatives - this could include washing/reuse services, development of new SUP-free materials, bottle collection and deposit schemes, government subsidies, or local collaborations for on-island bottling, or otherwise • Explore opportunities for reusable alternatives or increase the collection and recycling for local juices • Expand the current SUP import ban to fossil-based plastic grocery bags based on polymer and not based on labeling • Develop messaging to address community concerns around reuse and refill models, potentially in collaboration with the Ministry of Health, and ensure operations are hygienic, safe, and sustainable
COLLECTION 	**Findings:** Investigation into waste collection methods was conducted through stakeholder interviews, site visits to waste collection sites, and reviews of existing waste characterization and related literature. While Dominica has a relatively low per capita waste generation rate compared to other parts of Latin America and the Caribbean, it has a comparatively higher percentage of plastic in the waste stream, presenting challenges for waste diversion and recycling. Coverage for household waste collection across the island is high, but more infrastructure may be needed to ensure waste is properly transported and disposed of after pickup. Household waste sorting and providing source separation waste bins will be important for maximizing diversion from the landfill. **Opportunities:** • Incentivize and develop clear infrastructure (e.g., marked or colored bins) to support household separation of waste that can maximize recycling, composting, and landfill diversion • Ensure strategic and segregated collection infrastructure for key events on-island, such as local holidays, cultural events, festivals, and others • Explore funding options to obtain new collection infrastructure, such as additional collection trucks and potentially transfer stations across the island to decrease the likelihood of trucks dumping waste inland and in ravines • Take lessons learned from other Caribbean nations (such as case studies from Aruba) on ways to address C&D waste, potentially by developing a dedicated landfill or collection area for that type of waste on the island, creating local business opportunities around recycling and repurposing of that waste, or others; similar solutions could be explored for addressing derelict automobile waste in Dominica • Where possible and appropriate, expand upon the household collection model used in the Kalinago Zero Waste pilot to maximize source separation and diversion • Explore the possibility of engaging the cruise ship sector and potentially other trade sectors in transporting recyclable waste either back to mainland ports with enhanced solid waste management infrastructure or to other islands with complementary infrastructure in attempts to reach regional economies of scale
END OF CYCLE 	**Findings:** The one landfill in Dominica, Fond Cole, is rapidly reaching capacity and only has around 15 years of capacity left if the current expansion is completed. Efforts should be focused on waste diversion away from landfill and optimizing reduction, reuse, recycling, and composting options. Key infrastructure is needed locally, such as a material recovery facility, along with end-markets for waste that could be shared regionally to reach economies of scale. The Kalinago Zero Waste pilot has provided a strong example for

	household source separation, messaging and outreach, and incentives that can help reduce the amount of waste sent to landfill. There are also key opportunities to align solid waste management (SWM) with local business, tourism, disaster preparedness, and climate resilience. **Opportunities:** ● Develop a National Action Plan to strategize around and prioritize interventions for waste reduction, waste management infrastructure, community outreach and education, alternative materials, business opportunities, and other actions to increase Dominica's circular economy ● Explore funding opportunities for priority SWM infrastructure needs that would contribute significantly to waste diversion, such as industrial composting and/or anaerobic digestion, material recovery facilities, crushers and balers, and others ● Focus funding and resources towards opportunities for waste diversion away from the landfill and away from methods or technologies that may create additional waste or unintended environmental or health consequences, including continuing with and expanding upon the Recycle OECS pilot ● Engage with other Caribbean countries on opportunities for shared recycling markets, shared waste processing infrastructure (e.g., tire shredders, glass crushers, etc.) and economies of scale - this could be started with other countries that have conducted similar analyses and/or are going through similar recycling pilots, such as Grenada, Saint Lucia, and Antigua & Barbuda ● PET bottles could be a key focus for the increase of collection and recycling and may require investment in infrastructure, EPR, community awareness campaigns, and identification of end-markets - it would also be useful to collaborate regionally to ensure economies of scale for proper management of PET ● Ministries could include waste management explicitly in any further disaster preparedness, disaster relief, and climate resilience planning in Dominica, and ensure alignment across departments, agencies, and offices within the government ● Identify creative solutions to supplement funding for government-led solid waste management, such as additional zero-waste, circular economy, or sustainability taxes for incoming visitors or tourism operators such as cruise lines - similarly, a portion of the funds that private companies pay for importing goods as part of the Environmental Tax in Dominica could also be allocated towards waste management and circularity initiatives ● DSWMC has collaborated in the past with fishermen on waste management, but it would be beneficial for a more formal relationship or set of messaging to be developed around best practices for disposal of fishing gear, particularly nets, traps, oil, empty ice bags, and other problematic items
LEAKAGE 	**Findings:** Litter surveys were conducted across 50 1x1 km^2 land-based transects across the island, 10 coastal and beach locations on the west coast, and along a 20 km stretch of nearshore ocean on the west coast. In addition, 11 1L water samples around the island were surveyed for microplastic concentrations and characterization. The majority of land-based litter (~70%) was plastic. Common items included hard plastic fragments, plastic food wrappers (including small plastic bags from candies and ice pops), plastic bottles, and plastic bottle caps. Slightly lighter litter densities were observed on beach and coastal areas. Open dumping, particularly along the coast and for C&D waste, also presents a key challenge. Interventions should be targeted at preventing land-based litter from entering the ocean via key pathways, such as rivers, canals, and storm drains. **Opportunities:** ● DSWMC could explore collaborations with the Bureau of Standards and local schools to increase litter and microplastic monitoring across Dominica to further research major sources, sinks, and potential health concerns

	• Trash intervention mechanisms could be placed along rivers, canals, storm drains, coastlines, and other major land-based sources of marine debris across the island; this could be done in collaboration with DOWASCO • Conduct further research into the prevalence and potential health impacts of microplastics in key commercial fish species in Dominica • Engage local tourism operators in documenting and removing litter and debris, particularly from the marine environment (such as dive operators, whale watching trips, and others) • Work with local school groups, clubs, and businesses to include cleanups as part of regular events, particularly beach cleanups, and continue initiatives such as the annual Clean A Mile and International Coastal Cleanup • Encourage the use of technology like the Debris Tracker App or others to collect litter data in a standardized format across the island that can be used to track changes over time • NEP efforts could continue to be funded and supported across the island; where possible, conduct monitoring in those areas to continue demonstrating their positive impact on road cleanliness • Provide support for enforcement of Litter Act fines, potentially through additional Litter Wardens in rural areas of Dominica

Conclusion

This study offers the first-ever island-wide CAP to investigate the CE of plastic within the context of Caribbean SIDS. The CAP findings demonstrate opportunities for domestic and regional cooperation around EPR and DRS, particularly for PET beverage bottles, which were a high proportion of land-based litter, coastal/beach litter, nearshore marine debris, and the predominant polymer found in offshore microplastic sampling. Findings highlighted local business opportunities around manufacturing SUP alternatives, reuse models, and product delivery systems that could reduce waste and reliance on imported products. MLP presents a significant challenge on the island, as imported goods are often packaged in this material, but it is likely to end up littered in the environment. The current SUP import ban was found to be effective for preventing the use and littering of problematic items such as EPS, but it was also found that gaps in the policy have led to the import of mislabeled items (such as black plastic bags labeled ‘biodegradable LDPE’), and have also led to confusion around how to properly manage the alternatives that are being imported and used. Findings suggest that household waste sorting coupled with increased collection and infrastructure for recycling and composting could be beneficial for waste diversion from the landfill, which is rapidly nearing capacity. This has already been demonstrated through pilot projects, such as the Kalinago Zero Waste Initiative. Litter data and the hydrological profile of the island also highlighted the need for litter capture in waterways, along streams, and at storm drain outputs, particularly to protect the local sperm whale population and coral reef ecosystem on the west coast of the island.

Given the current national, regional, and international efforts around plastic pollution, it would be beneficial to replicate the CAP in Dominica in several years to measure the impact of policies,

campaigns, and the National Action Plan. There is also a need for duplication of the CAP in other Caribbean SIDS to help refine opportunities for a regional approach to build economies of scale, particularly around recycling. Conducting other CAPs in the region would also be beneficial given the interconnected nature of plastic pollution in the Caribbean; for example, on the east coast of Dominica near critical leatherback sea turtle nesting grounds, litter surveys demonstrated high quantities of plastic fragment litter which likely originated from elsewhere and was transported to the Dominican coast over time. A high proportion of convenience products also originated from other Caribbean SIDS and countries, further demonstrating the need for regional collaboration. There is also a need for ongoing monitoring of plastic pollution in Dominica. The CAP presents findings for a single snapshot in time, and there may be a benefit to replicating in the rainy and dry seasons, before and after hurricane season, before and after major festivals like Carnival, and other influential events to better identify needs and opportunities.

Islands provide unique opportunities and testing grounds to foster circular systems, and the concept of circularity is particularly important for islands due to a general lack of land space for landfill, an economic reliance on external imports of products often packaged in plastic waste, high quantities of tourism and transient populations, and the presence of natural ecosystems that are often important from a societal, environmental, and economic perspective. Waste reduction and diversion will be critical for Dominica in the coming years to meet the growing demands for SWM and pollution prevention. In many ways, plastic pollution prevention is synonymous with resilience in Dominica. If the island is to become the first climate-resilient nation, per its national strategy, then waste management and pollution prevention must be incorporated into planning across the government, private sector, and communities on the island. The CAP findings are already being used in proposals for SWM infrastructure in Dominica, such as a new MRF at the landfill, in outreach and education campaigns around sorting at source, in school programs and competitions across the island and the Lesser Antilles, and importantly they have been used to inform a National Action Plan on Solid Waste Management and Plastic Pollution Prevention for Dominica. With their role in the region as well as in the UN global plastic agreement negotiations, Dominica has the opportunity to be a leader in developing a circular and resilient island nation.

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Appendix

Table A1: Full List of Debris Tracker Litter Items and Associated Material Categories

Material	Items
C&D Materials	Aggregate & Brick Bolts, Nails, and Screws Building Materials Lumber Other C&D
Cloth	Clothing Towels or rags Fabric Pieces Other Cloth
E-Waste	Batteries E-Waste Fragments Wire Other E-Waste
Fishing Gear	Buoys and Floats Fishing Line Other Fishing Gear Plastic Net or Net Pieces Plastic Rope
Glass	Glass Bottle Glass or Ceramic Fragments Other Glass
Metal	Aluminum Foil Aluminum or Tin Cans Foil to-go container Metal Bottle Caps or Tabs Metal Fragments Other Metal
Organic Waste	Food Waste Other Organic Waste
Other	Other Popsicle or lollipop Stick

Other Plastic Products	Bulk Bags Flip Flops or shoes Plastic String, Tape, or Packing Straps Rubber Bands Trash bag Tires Balloons Plastic toys or balls Car Parts Hard plastic jugs or containers Other Plastic
Food-Related Paper	Paper cups Paper food box or container Paper plates or bowls Compostable paper cups Paper food wrapper Compostable food box or container Napkins Other Food-Related paper
Paper	Office paper and newspaper Tags, tickets, and receipts Corrugated Cardboard Paper fragments Other Paper
Personal Care Products	Blister Pack or other pill packaging Cotton Buds Ear plugs Personal Care Product Sachet or packet Toothbrushes Toothpaste or Other Product Tube Flossers Feminine products Needles and syringes Other Personal Care Product
Food-related plastic	Foam cups Plastic cups Compostable plastic cups Cup Lids Plastic Bottle Aseptic cartons Mini alcohol bottles Plastic Bottle Cap Plastic Food Wrapper Condiment packet or container Plastic Grocery Bag Sandwich or snack bags Plastic Utensils

	Straws Foam to-go container or clamshell Plastic to-go container or clamshell Compostable plastic container or clamshell Other Food-Related Plastic
Plastic Fragments	Film Fragments Foam Fragments Hard Plastic Fragments Rubber/ tire fragments Other Fragments
PPE	Disinfectant Wipes Disposable Gloves Face Masks Other PPE
Tobacco Products	Cigarette Packaging Cigarettes Tobacco Sachets or packets E-cigarettes and vaping Plastic cigar/cigarillo tips Lighters Cannabis-related waste Other Tobacco Product