# “Trash is just treasure in the wrong place”: The social metabolism of waste in Grenada

by

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The following served on the Examining Committee for this thesis. The decision of the Examining Committee is by majority vote.

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## Author's declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

# Statement of contributions

Allison Elgie is the sole author for Chapters 1, 2, 3, 5, 6, and 7 which were written under the supervision of Dr. Simron Jit Singh and with guidance from Dr. Mary Louise McAllister. These chapter were not written for publication. Exceptions to sole authorship of material are as follows:

## Research presented in Chapters 4:

This research is conducted by Allison Elgie under the supervision of Dr. Simron Jit Singh and Dr. John N. Telesford. Allison Elgie made the initial conceptualizations of the study, established the methodology, collected the data, conducted the analysis, drafted the original manuscript and visualizations. Allison Elgie wrote the draft manuscripts, on which all co-authors contributed intellectual input on. Dr. Simron Jit Singh contributed to the study conceptualization and methodology and reviewed and edited the manuscript. Dr. John N. Telesford contributed to the study conceptualization and provided resources for data collection and reviewed and edited the manuscript.

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# Abstract

Within a modern, globalized world, islands face evolving and complex development constraints related to managing scarce resources, maintaining fragile natural environments, reducing consumption and waste within bounds of their limited carry capacity, and maintaining adequate economic and social systems for thriving populations. Grenada, a tri-island Caribbean state (population: 112,003) is no exception. For this dissertation, I investigate the impacts and threats of solid waste on small island state sustainability. Using a case study approach, my research askes an overarching question: What opportunities exist for islands to sustainably manage their waste?

I investigate Grenada's waste management system using the social metabolism approach. Social metabolism theorizes that sustainable development, including transitioning to a more sustainable waste management system, is dependent on both the biophysical, material flows (i.e., how much 'stuff' is extracted from and dumped in the environment) and the social processes that support these material flows (i.e., the institutions and cultural norms that govern).

Material flow accounting (MFA) was selected as a method to account for the biophysical flows of waste in Grenada. The result of the MFA demonstrates the importance and value of measuring and assessing waste management systems. Grenada's economy is characterized by a one-way, linear flow of materials. Products are imported, manufactured, used, and discarded in the open dumpsites or disposed in one of several illegal dumpsites throughout the nation. Despite comparatively low generation rates, Grenada's dumpsite are at capacity, and in absence of changes to current waste accumulation, these dumpsites are teetering on an environmental tipping point that threatens social, environmental, and economic health. Governance actors, particularly policy makers, *cannot manage what they cannot* measure, therefore sound data is critically important to guide transitions to sustainable waste management systems. MFA is one such means for waste managers and policy makers to assess their sociometabolic risk and understand the resource potential of waste materials. But material flows are also driven by institutional elements like legislation, regulation, policies, normative positions and engrained social habits that are culturally supported.

To assess social-cultural aspects of Grenada's waste metabolism, I engage in two separate, yet interrelated studies. Through expert interviewees and government document analysis, I assessed the governing system impacting Grenadian waste management. The results, presented in Chapter 5, demonstrate that Grenada has a legacy of implementation and institutional challenges related to a

project-based, end-of-pipe approach that has failed to deliver adequate waste management. Current governance mechanism and institutions are lacking comprehensive coverage, and are outdated, absent or inadequately enforced. This governance gap is reinforced by lack of data for decision-making.

Public participation in waste management forms an important basis for effective decision making and strategy, as it is a key aspect of forming legitimate governing structures and institutions. As the public is a key participant in everyday waste management practices, it is critically important to understand habits, behaviors, perspectives, and concerns of citizens. To understand the role and potential contributions of citizens in waste management, I undertook a grounded, "bottom-up" investigation of the challenges and opportunities for Grenadian waste management. Citizen interviews, rich pictures, and focus groups were the primary method of data collection, and were triangulated through an analysis of newspaper articles, and my own observations and collected artifacts (e.g., field notes and photographs). Research participants depicted a variety of perspectives; but, generally – and most importantly - they demonstrated the importance of citizen participation in waste management governance and social metabolic research. The results are organized around three roles that Grenadian citizens play in the waste management system: as participants and enablers of waste management; as stewards of the environment concerned with their health, environmental justice, and pollution in their communities; and as islanders offering local knowledge, innovation, and insights into what is possible in Grenada. The results offers a glance at what could be gained through a more representative, nation-wide consultation, and looking inward – instead of outward – for solutions to sociometabolic risk associated with waste management in Grenada.

This dissertation makes a key contribution to the literature by looking at both the material and socio-cultural aspects of waste management to provide a comprehensive, systems-based analysis of waste management as a problem within a social-ecological system. An island appropriate circular economy is one aspirational means of achieving a sustainable waste management system. From the results, I make practical, specific recommendations (with reporting indicators and financial implications) to strengthen waste management governance, including updating legislation and improving participation in global governance agreements and importantly, improve public participation through engagement, infrastructure availability and education.

Improving the waste management system is integral to the sustainability of the Spice Island and *Pure Grenada.* **The Grenadian government must increase investment in waste management, taking**

**a systematic approach to addressing the root causes, governance concerns and enhance public participation in the process.** In absence of changes to current waste accumulation, the waste management system is teetering on an environmental tipping point that threatens social, environmental, and economic health, and Grenada's progress on the Sustainable Development Goals.

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# Dedication

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To the savers, the re-users, the buy-nothing-ers, the make-doers, the do-it-yourself-ers, the thrifters. To the people stopping the train of mindless consumption and saying *this is enough*. Thanks for the inspiration and hope.

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# List of Abbreviations

| | |
|---|---|
| AD | Anaerobic digestion |
| CBS | Central Bureau of Statistics |
| EMA | Environmental Management Act |
| EPR | Extended Producer Responsibility |
| EVL | Environmental Levy |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GSWMA | Grenada Solid Waste Management Authority |
| ICI | Industrial, commercial, and institutional |
| MFA | Material Flow Accounting |
| MOU | Memorandum of Understanding |
| RLES | Resource-life extending strategies |
| SES | Social-ecological system |
| SIDS | Small island developing state |

# Chapter 1 Introduction to the dissertation

## 1.1 Research context

The world has a metabolic outflow problem. Quite simply, humans produce too much waste, and the evidence is both staggering and heart-wrenching. Humanity produces an estimated 2.01 billion metric tons of municipal solid[1] waste every year, and at least 33% of this is managed in a way that threatens the environment (Kaza et al., 2018). In the global south, waste picking in the informal recycling sector are the exclusive or predominant means of resource recovery (Velis, 2017). Despite their contribution to the waste management system, waste pickers experience no labour or health protections. An estimated 4.8-12.7 million metric tons of plastic entered the world's oceans in 2010, threatening marine life as well as human life as plastics makes its way up the food chain (Jambeck et al., 2015a). There is a paradox of depleting virgin resources and growing material scarcity, while also continuing to allow resources to "languish in discarded products" in waste management systems (Velenturf and Purnell, 2017, p. 1). Using a sociometabolic perspective, my dissertation investigates the impacts and threats of solid waste to the sustainability of the small island state of Grenada. Through a mixed method case study, I quantify how much waste is generated, analyze the role of governance and legislation in the management of waste, document how poor management impacts Grenadians (both present and future), and demonstrate what can be gained through meaningful public participation and consultation with citizens.

From both a scientific and pragmatic perspective, island social-ecological systems (SES) provide an excellent context to understand sustainability challenges, such as waste management, due to their manageable size and limited entry points (Chertow et al., 2013; Deschenes and Chertow, 2004; Vitousek, 2002). Within a modern, globalized world, islands face evolving and complex development constraints related to managing scarce resources, maintaining fragile natural environments, reducing consumption and waste within bounds of their limited carry capacity, and maintaining adequate economic and social systems for thriving populations (Deschenes and Chertow, 2004). There is a fragile balance of maintaining and reproducing island social-ecological systems, while acknowledging the limits of the planet and concurrently maintaining adequate social-cultural systems and institutions that support human wellbeing (Petridis and Fischer-Kowalski, 2016; Raworth, 2012).

[1] Municipal solid waste usually includes household, commercial and institutional waste and exclude industrial and manufacturing.

While this fragile balance occurs in all social-ecological systems, islands are unique in their experience of *immediacy* and *urgency* in addressing the confluence of sustainability challenges (Chertow et al., 2013). The COVID-19 pandemic further underscores and undermines small island states' abilities to respond to climate breakdown and the resultant extreme weather impacts, particularly in tourism dependent, import dependent economies (Thomas, 2020; Thomas et al., 2020).

For this dissertation, I investigate the impacts and threats of waste to small island state sustainability. Waste is defined broadly as "any material or object the holder discards or intends to discard" (Haas et al., 2016, p. 261). There are a variety of characterisations of waste: solid waste, industrial waste, municipal solid waste, and wastewater. Waste is both a material reality (i.e., materials ending up in dumpsites or down the sewer) and a social construct (i.e., the colloquial "one person's trash is another one person's treasure"). My research is limited to solid waste or materials that are generally deposited as an outflow on land. This boundary is practical, based on the field work and partnerships developed to conduct the research in Grenada (Chapter 3).

With the backdrop of a global outflow problem, small island states have their own acute and pressing waste management challenges (Eckelman et al., 2014; Owens et al., 2011; Phillips and Thorne, 2012; UNEP, 2019a).

- Islands are generally small geographical spaces, therefore have limited land space to develop waste management infrastructure including landfills
- Changing consumption patterns and connections with global trade networks, leading to changes in waste composition (i.e., more non-biodegradable packaging)
- Like other coastal communities, islands are victims of an influx of marine litter making way to their shores from poor waste disposal elsewhere
- Lack of technical capacity amongst waste management professionals
- Islands are isolated or remote, making it economically infeasible to ship materials off the island for recycling in other systems.
- Islands are often, especially in the Caribbean, reliant on tourism for economic development leading to growing demand for products, which leads to increases in waste.
- Lack of economies of scale to facilitate cost-recovery on waste management initiatives

- Prevalence of illegal dumping
- Dumpsites remain a prevalent and extremely problematic disposal method

So, given all the challenges, can a small island developing state (SIDS) have a sustainable waste management system? This question constitutes the basis of my dissertation. Sound waste management is integral to islands developing sustainably, adapting to the threats posed by climate change, and ultimately achieving the sustainable development goals (SDGs) (Lenkiewicz, 2016; Schroeder et al., 2018), particularly SDG 12. Consequently, island waste management has become an important sustainability issue and deserves attention from academia and policy makers alike.

Up until the COVID-19 pandemic, islands were experiencing growth in tourism, changing consumption patterns, and increasing dependency on imports. This has resulted in a gargantuan challenge of dealing with an overwhelming volume and diversity of waste. In the small island Caribbean state of Grenada, growth in tourism and educational services, and dependency on imports have led to an increase in complexity of waste materials on the island. Yet, waste management practices, disposal technologies, and diversion opportunities have remained largely stagnant, or absent. Consequently, mixed household, commercial, industrial, and hazardous waste are rapidly accumulating in open, coastal dumpsites that lack pollution control (i.e., gas and leachate management, and daily covering) and are running out of capacity. Unfortunately, outcomes of donor-funded projects, such as the building of a sanitary landfill in 2001, have not been sustained. Moreover, as of 2021, plans for repairing and constructing a sanitary landfill are modelled to last a mere few years with business-as-usual generation. It is evident that waste management practices in Grenada must change; continuation of current patterns threatens sustainable development, progress on the SDGs, and externalizes remediation costs to future generations of Grenadians. Therefore, this research is timely in its investigation of the ongoing challenges with waste management in Grenada.

Poor waste management systems have been recognized as a key sustainability hurdle for small islands for several decades. Global development frameworks like the Barbados Program of Action (BPOA), the Mauritius Strategy, and SAMOA Pathways framework make it apparent that waste management is an important issue at the global governance level. The *St. George's Declaration of Principles for Environmental Sustainability in the OECS* address environmental challenges, including waste management at a regional level (OECS, 2006). Caribbean regional projects like the *OECS Solid and*

*Ship Generated Waste Management Project* and ongoing work through the Basel Convention Regional Centre have focused on developing waste management infrastructure and technology in the region. Nonetheless, open dumping and pollution from solid waste continues to threaten the wellbeing and environmental health of islanders and islands throughout the Caribbean, particularly in Grenada (Kinnaman, 2010; Riquelme et al., 2016). Where progress has been made, it often manifests as an end-of-pipe solution that focuses on what to do with the waste generated (i.e., more efficient collection, installations of sanitary landfills and incinerators) instead of addressing the drivers of waste such as changes in consumption patterns and economic growth, and by measuring and communicating the potential impact of poor waste management practices. End-of-pipe responses do not address the root of the problem; furthermore, these responses are often dependent on technical prowess and technologies that can quickly become unserviceable in the island context. This necessitates a different, more systematic approach to waste management on small island states, as small islands cannot mimic the trajectories of non-island waste management systems.

## 1.2 Purpose, and objectives of the research

The purpose of this research is to identify and evaluate the impacts and threats of solid waste on the sustainability of the small island state of Grenada, using a sociometabolic lens. The dissertation is guided by an overarching research question: **What opportunities exist for islands to sustainably manage their waste?** To answer this question, four sub-questions were addressed (Table 1.1) First, I needed to understand Grenadian's waste management system from a biophysical perspective, including the material flows of the waste management system and problematic materials (Q1, Q2). A key gap in the literature is that waste management research tends to focus on the biophysical, material aspects of waste management to the ignorance of governance structures (institutions, legislation and policy) (Q3) as well as citizen's participation in waste management (Q4).

| **Specific research questions:** | |
|---|---|
| **Q1** | What are the material flows of Grenada's waste management system? |
| **Q2** | What are the material flows of problematic materials like plastics, tyres, and motor oil? |
| **Q3** | What are the implications of governing systems (institutions, legislation, and policy) and governance actors on the material flows of waste in Grenada? |
| **Q4** | From a citizen's perspective, what are challenges in an island waste management system? |

Table 1.1 Research questions

This dissertation contributes to island sustainability and waste management research by providing contextually relevant research to transition Grenada's waste management system towards a more

sustainable system. Overall, I am advocating for a more systematic approach that recognizes that waste materials are a product of social and economic decisions across scales, and addresses those factors. This dissertation demonstrates the merits of responding to waste management challenges by addressing the root causes rather than by using short-term responses like building more landfills without rethinking consumption patterns.

## 1.3 System approaches to sustainability research

The scale and complexity of the global waste problem, that manifest as localized sustainability stressors on islands, demands integrated and system-wide considerations. Systems thinking challenges the reductionism of traditional analytical science by recognizing that the *relationships* between the 'parts' (e.g., actors, stakeholders, and drivers) are equally as important for understanding as the parts themselves. The logic of systems thinking is narrated in the precautionary parable of the blind men and the elephant: one cannot possibly understand a system by simply understanding the parts – you must also understand how the parts fit together (Meadows, 2008). The 'power' of thinking in systems lies within the problem-solving arena as it helps to explain system structures and patterns of causality (Chai and Yeo, 2012). This power, however, is limited based on an ontological position in system-thinking that you can never completely understand the system. In other words, all knowledge is fragments of a whole.

Systems thinking originated in the 'hard' sciences, with intellectual roots in von Bertalanffy's (1950) General Systems Theory. Hard systems involve the quantification of seemingly objective variables to optimize performance (Stephens and Hess, 1999). Mathematics, computer modelling, and systems design engineering play an important role in hard approaches to systems thinking. A hard systems approach assumes that system goals can be easily defined, and systems can be engineered to meet these goals while measuring progress quantitatively (Chai and Yeo, 2012; Checkland, 1981). Hard system approaches are appropriate for well-defined problems that can be measured objectively but are not as suitable for problems that are socially or politically oriented (Checkland, 2000).

Soft system approaches emerged out of growing contention with quantitative, objectivist systems research (Checkland, 1981). Patton (2002) argues that systems perspectives that include qualitative research are necessary for understanding the complexities of real-world problems. Soft system approaches are arguably more appropriate for *wicked problems* (Checkland, 2000) (Section 1.3.5). Qualitative, soft system approaches may help researchers to define the problem more clearly

through incorporating multiple perspectives into the research (Chai and Yeo, 2012), yet they are not as readily applied in systems thinking and especially waste management and circular economy research (Newhouse and Schmit, 2000).

### 1.3.1 Social-ecological systems

The complexity of sustainability problems, like waste management, suggests that disciplinary approaches are insufficient for guiding impactful and durable solutions. This dissertation uses social-ecological systems as the unit of analysis for conducting system-level investigations. Social-ecological systems recognize that sustainability problems are not just "social" or "ecological" but "social-ecological" in nature (Collins et al., 2011; Folke, 2006; Ostrom, 2007; Singh et al., 2013). Redman and colleagues defined social-ecological systems based on the following characteristics: (1) a coherent system of biophysical and social factors that regularly interact in a resilient, sustained manner; (2) a system that is defined at several spatial, temporal, and organizational scales, which may be hierarchically linked; (3) a set of critical resources (natural, socioeconomic, and cultural) whose flow and use is regulated by a combination of ecological and social systems; and (4) a perpetually dynamic, complex system with continuous adaptation (Redman et al., 2004). More simply, social-ecological systems are defined as nested, multi-scaled systems that provide essential services to society and highlight patterns, processes, and feedbacks that link the social and environmental both within and between levels and scales (Berkes and Folke, 1998; Liu et al., 2007).

This study conceptualizes waste management as a social-ecological problem: it is nested within challenges of consumption, resource use, and land-use; it is multi-scaled across space and time; it is a by-product of socioeconomic systems and therefore, an essential service for both social gains and economic exchange within the sustainable development framework (United Nations, 2015). There are numerous frameworks for analysing social-ecological systems, ranging from the SES Framework, Ecosystem Services framework, and Drivers-Pressures framework (Binder et al., 2013). I selected the social metabolism approach (Section 1.3.2) for its usefulness in bridging natural and social science, and incorporating multiple sources of data (including data from field work) to provide useful insights for policy formulation (Haberl et al., 2019).

From a theoretical standpoint, like many social-ecological systems approaches, social metabolism allows for the assessment of both biophysical and social-cultural aspects of social-ecological sustainability. This is particularly important for island social-ecological systems, as the immediacy and intimacy of sustainability issues are far greater compared to continental social-ecological systems

(Chertow et al., 2013). Recent insights from social metabolism research have demonstrated the framework's ability to identify the impacts and pressures of human activities on the environment. It also allows for monitoring resource use at a country or regional level, and assessing how to close material cycles with concepts like the 'circular economy' (See Chapter 2) (Haberl et al., 2019). In this dissertation, I assess the sustainability of Grenada's waste management system. Therefore, understanding environmental boundaries (e.g., waste absorption capacity) and pressures, maladaptive practices (e.g., reliance on imports, depopulation/outmigration trends, and accumulation of waste), and opportunities for resource reduction, efficiency, and reuse (e.g., components of a circular economy) made the social metabolic framework a suitable research framing.

Pragmatically, the social metabolism approach has been widely used to investigate the sustainability of human-nature interactions *on islands*. Seminal work began with my dissertation supervisor, Dr. Simron Singh (Singh et al., 2001; Singh and Grünbühel, 2003), and has since expanded to a growing body of research through the Vienna School of Social Ecology, the development of the Metabolism of Island network, and growing sets of publications, such as the latest special issue entitled the Metabolism of Islands (Singh et al., 2020). The social metabolism framework is well-suited to incorporate Material Flow Accounting (MFA), which is one methodological means of accounting for the biophysical stocks and flows. Island characteristics (such as limited ports of entry, small geographical spaces) make MFA a particularly suitable approach to island resource accounting. Furthermore, the social metabolism framework allows for the incorporation of disparate – yet relevant – information required to understand island social-ecological systems. As a researcher, I am drawn to field work, therefore, it was important to me to frame my research to include observation, first-hand data collection and qualitative methods. The social metabolism allows for layering of information and nuance, making it suitable for assessing complex, wicked problems (Section 1.3.5); this aligns with my pragmatic philosophical position as a researcher (Chapter 3). The next section addresses social metabolism framework in detail.

### 1.3.2 Conceptual framework: Social Metabolism

Sustainable development, including transitioning to a more sustainable waste management system, is dependent on both the biophysical, material flows (i.e., how much 'stuff' is extracted from and dumped in the environment) and the social processes that support these material flows (i.e., the institutions and cultural norms that govern).

At the biophysical level, human-environmental relations are characterized by social metabolism, the organizational process in which material and energy flow within and between social-ecological systems. The use of metabolism (a biological concept) to illustrate the relationship between humans and the environment can be traced back to Marx (Singh and Haas, 2013), but was popularized through "industrial metabolism" (Ayres and Simonis, 1994) and "social metabolism" (Fischer-Kowalski and Haberl, 1993) in the late 20th century. Social metabolism is also a framework for assessing the sustainability of a social-ecological system through an understanding of both material flows and social processes (Fischer-Kowalski and Weisz, 1999; Haberl et al., 2004).

The social metabolism framework theorizes the socio-cultural system, and the natural system are two tightly coupled, dichotomous systems (Singh and Haas, 2013). Figure 1.1 depicts the *natural sphere* consisting of the material world (i.e., marine, and terrestrial systems) and the *socio-cultural sphere*, which communicates legal and cultural organizing processes (Petridis and Fischer-Kowalski, 2016). At the interface of the cultural and material spheres lies the *hybrid*, where biophysical structures of society are reproduced and regulated over time. Interactions between the socio-cultural and natural systems are always mediated by society, therefore humans and human institutions influence the sociometabolic process experienced by a social-ecological system (Singh and Haas, 2013). For example, human reproduction is both a cultural and biological process requiring inputs from both the natural system and cultural system. Likewise, the development of infrastructure for socioeconomic activities is organized through cultural expectations, knowledge, and system of meaning as well as material inputs from the natural world.

The (un)sustainability of a social-ecological system depends on the interactions between the natural and socio-cultural systems within the *hybrid sphere* (Haberl et al., 2004). Anthropocentrically, a society is socio-ecologically sustainable if it can *reproduce* its social-cultural system overtime by organizing a permanent throughput (flow) of materials from the natural environment and manage flows of information to ensure equal distribution of the metabolism (Schandl et al., 2002). Schandl et al. (2002) and Haberl et al., (2019) outlines some key assumptions about societal metabolism. First, societies, at a minimum, must organize a permanent throughput of material and energy that maintains and operates societal stocks like humans (e.g., enough calories to survive) and the production of artefacts, like buildings and durable infrastructure. Second, the characteristics and patterns of a social metabolism determines a society's environmental pressure, and therefore needs to be compatible with both the supply and the sinks (e. g., waste absorption capacity) of the natural

system. Third, societies engage in purposeful and deliberate organization of natural systems to ensure a constant throughput of material and energy. Fourth, this deliberate and purposeful organization is possible using the labour process. In the absence of labour (or machine replacements) metabolism of a society is simply not possible. Lastly, the laws of the natural system (i.e., laws of thermodynamics) apply to the metabolism, that is what is available in terms of supply and sink for waste.

Through a combination of material stocks and flows (and the accompanying social, cultural choices), a social-ecological system can fall into a 'metabolic trap' and become exposed to (socio)metabolic risk (Singh, 2020). In this respect, four sustainability challenges can threaten a society's socio-ecological sustainability: (1) resource scarcity, where inputs are inadequate to maintain the stocks of a society (2) a reliance on imports to fulfill needs resulting from resource scarcity, 3) difficulty of absorbing the outputs of waste within the domestic social-ecological system, especially if there are a lot of imported materials, and (4) an unequal distribution of the costs and benefits of the social metabolism, resulting poor social outcomes, inter-and-intra generational inequity, and ecological injustices (Schandl et al., 2002). This dissertation addresses all four of these sustainability concerns, with a particular focus on the ability of an island to absorb outputs of waste, which is mediated and impacted by a society's reliance on imports, and an unequal distribution of the ecological injustices associated with poor waste and pollution management.

For social metabolism studies, two interactions within a social-ecological system are relevant: the internal *self-organization* of the system, and the *biophysical exchange* with the surrounding system (Georgescu-Roegen, 1971; Schandl et al., 2002). These exchanges are depicted as red and green arrows, respectively, in Figure 1.1.

To understand the biophysical exchange ('Natural', in Figure 1.1), quantitative empirical work plays an important role, with the predominate method being 'material flow accounting' (MFA). The interactions between the social and hybrid spheres of the social metabolic framework are not widely understood (Fischer-Kowalski and Weisz, 2016). Yet, materials *do not often flow on their own*, and there is an important opportunity to incorporate soft-systems methods for understanding the social-cultural aspects in the social metabolic framework. Social cultural systems – including governing systems and institutions – regulate the environmental flows, enabling a social-ecological system to continue to reproduce itself over time (Fischer-Kowalski and Weisz, 1999). Recent research in Samothraki, Greece has identified key conditions for the reproduction of island livestock through

understanding the role of policy, social relationships, and transdisciplinary science (Petridis et al., 2017). There is a need to further this research, understanding ways in which governance, institutional arrangements, and policies impact the stocks, inflows, and outflows.

While social metabolic sustainability issues are present in all social-ecological systems, islands are particularly vulnerable to experiencing resource scarcity, a reliance on imports, and the resultant waste management challenges. To counter these challenges, Telesford and Strachan (2017) proposed four island sustainability principles in which a sustainable island system will uphold. First, the island system must not be systematically subjected to increasing concentration of materials extracted from the earth's crust. For example, building stocks built using extractive material (e.g., cement, stone) must be continually maintained and rebuilt using increasing amounts of extractive resources. Islands also tend to have a high reliance on imported fossil fuels to meet the energy requirements for continually reproducing the desired, modern social systems (Noll et al., 2016; Sundkvist et al., 1999). Second, the island system must not be systematically subjected to increasing concentrations of materials created in society. For example, many islands export solid waste to the mainland due to lack of capacity to store waste within the island system (Busch and Sakhel, 2016). Third, the island system must not be systematically subjected to degradation by physical means. As the reproduction of the social-ecological system is dependent on flows to the environmental system, preventing degradation of island ecological systems is largely dependent on socioeconomic decisions by islanders and island governments[2]. Lastly, the island system must not be systematically subjected to conditions that undermine their capacity to meet their own needs. By understanding how an islands social-ecological system is reproduce through sociometabolic stocks and flows, researchers can identify sustainable development challenges related to the maintaining throughput and the principles of sustainability.

[2] With exceptions, for example, inflows that are external to an island's governance system's control. Marine litter is one such inflow that is often outside of the control of a single island government. Also, sargassum seaweed develops based on nutrient outflows from other social-ecological systems.

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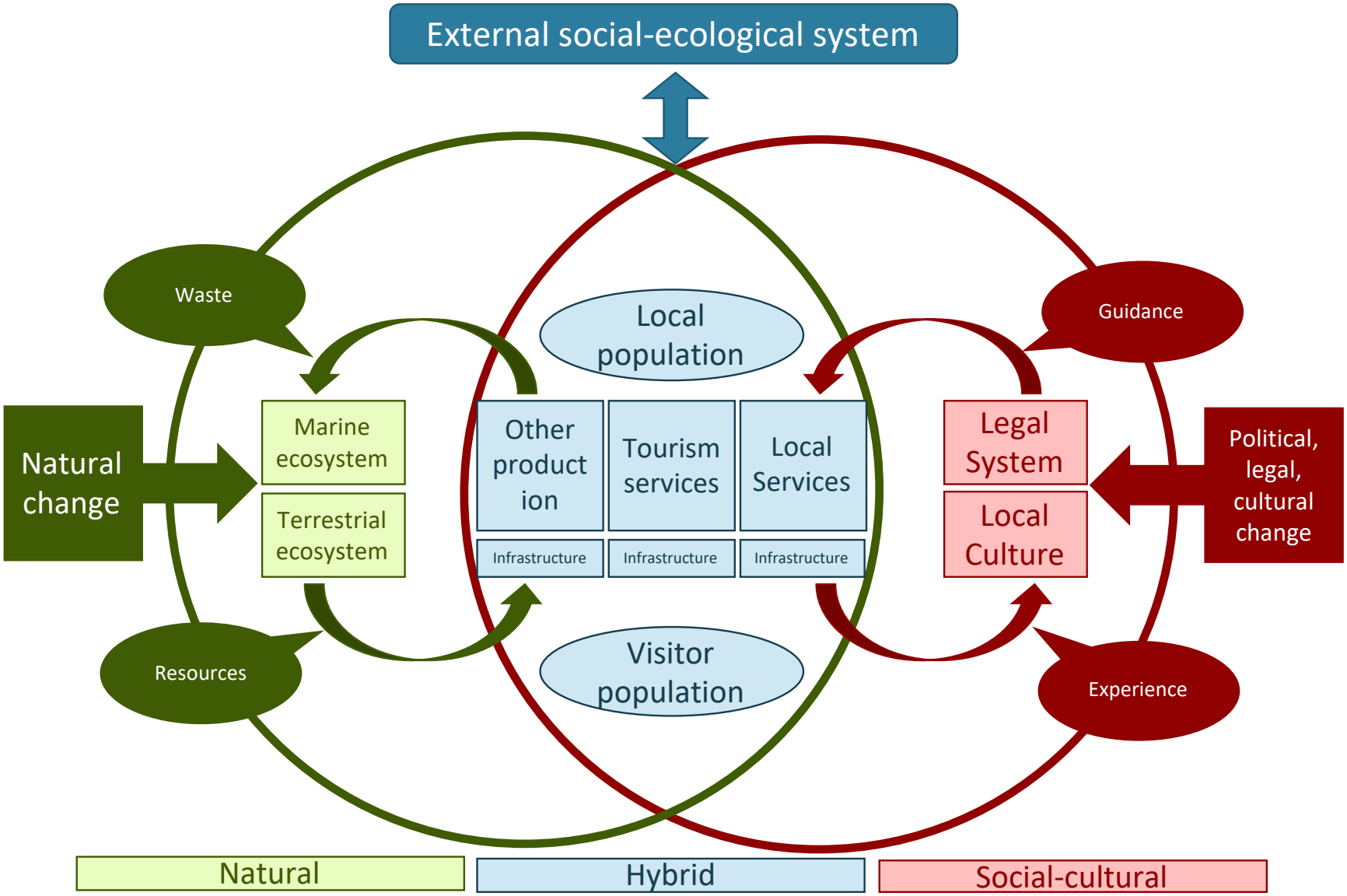


Figure 1.1 Sociometabolism framework, adapted from Petridis and Fischer-Kowalski (2016)

There is increasing evidence that natural capital is a limiting factor in the expansion of human colonization (Sundkvist et al., 1999). This confrontation with natural capital limits is particularly evident in island social-ecological systems, leading researchers to suggested that localities (regions, including but not limited to islands) need to employ 'island logic' (Busch and Sakhel, 2016), by developing self-sufficient systems that consumes fewer external resources and leverages local natural capital in a self-sustaining manner (Sundkvist et al., 1999). As demonstrated in economic, environmental, and social vulnerability literature – islands are far from self-sustaining, relying on outside sources of material, energy, and capital to reproduce their social-ecological system (Boruff and Cutter, 2016; Briguglio, 1995; Pelling and Uitto, 2001). Yet, islands also represent an opportunity to demonstrate what a self-preserving system can look like within the context of the greater global system (Busch and Sakhel, 2016).

### 1.3.3 Transdisciplinary research

This dissertation takes a transdisciplinary approach to research. Transdisciplinary research aims to develop a "collective understanding of an issue; it is created by including the personal, the local and the strategic, as well as specialized contributions to knowledge" (Brown et al., 2010, p. 4). This dissertation is influenced by guiding principles written by Russell (2010). I have outlined how I set out to employ transdisciplinary inquiry principles in Box 1.1. As a sole researcher investigating a complex problem, a transdisciplinary research project is both exciting and intimidating. I struggled with implementing my inquiry with complete openness, critical reflection, and introspection on my own value and purpose judgements. Throughout the research process, I was challenged to pause my judgements and be open to alternative perspectives.

In particular, I found it challenging to acknowledge my own values, assumptions and interests in the research process, as these ideas are deeply embedded in my positionality. For example, my held value that "*good citizens* store their garbage in their house until collection day" fails to acknowledge fears of disease and cleanliness, the realities of a tropical environment, and that this value is connected to my upbringing in a cold climate with houses large enough to store garbage. This value had to be acknowledged early on in the research – and allowed me to become open to conflicting and more nuanced positions held by research participants (See Chapter 5 & 6). But this is one example, and without doubt, there are positions and values that I have failed to acknowledge throughout the inquiry.

Therefore, this dissertation recognises the importance of transdisciplinary inquiry. I implement these principles (Box 1.1) to the best of my ability throughout the research process, but reflectively, I further acknowledge that some aspects of transdisciplinary inquiry are limited: the limits of a single researcher, the exclusion of voices based on position and access (both myself and participants), my unacknowledged values and interests that shape the inquiry in unknown ways, my ease of understanding and observing physical processes, and struggles with capturing the nuances of social-cultural phenomena, and my positionality of what is "sustainable" and recognizing the sustainability of the everyday behaviours of Grenadians as legitimate.

1. Knowledge is always partial, plural and provisional. Facts and logic are developed in a social context, and therefore I must acknowledge historical and cultural values in the inquiry. The world is complex, even island social-ecological systems are complex. Therefore, my inquiry will always be partial, and I cannot know everything. My plural ways of knowledge and inquiring are shaped from my values and interests, and, as a result of partial and plural approach, my knowledge is provisional and fallible.
2. Reliable knowledge is created through a social process of critical deliberation, in addition to evidence and reason, therefore requiring explicit acknowledgement of my values, assumptions and interests in the research process. My research cannot be restricted to disciplinary knowledge communities or exclude voices based on disciplinary commitments.
3. As a researcher, I must critically reflect on my purpose, agendas and values that influence the inquiry process, as this will influence the processes outcomes and consequences of my inquiry.
4. My ontological position is open, in that the world is both dynamic and heterogenous, and reality is both physical and cultural. Furthermore, the world exists independently from what I may think about it.
5. An inquiry includes both facts and values because inquiry and consequences are never value free, and both values and facts need to be accounted for in my judgements. To suggest or design interventions for improvement, I must be value oriented, including values like sustainability.
6. Knowledge must include interest in the ecological conditions on which life depends, therefore creating a pathway for concerns with ecological sustainability and social justice.

Box 1.1 Adapted from Russell (2010)

### 1.3.4 Post-normal science

From global to local scales, social-ecological systems are facing challenging policy arenas in which "facts are uncertain, values in dispute, stakes high, and decisions urgent" (Funtowicz and Ravetz, 2003, p. 1). Solid waste management is one such policy arena in which *post-normal science* is more

appropriate than traditional problem-solving approaches (Marshall and Farahbakhsh, 2013). Waste management concerns intersect with global risks from climate change, challenges of material use, consumption and economic development, social concerns for public health and sanitation, complex technologies, and concerns around resource management and local environments (Marshall and Farahbakhsh, 2013; Wilson, 2007). All of these 'drivers' face multiple perceptions and values from competing stakeholders and actors within the system, as well as biophysical constraints dictated by the ecological system.

Post-normal science, in contrast to 'normal science' as described by Kuhn (1962), recognizes that policy decisions are made under conditions of incomplete information, unpredictability, and require input from multiple, legitimate perspectives to develop a robust understanding of the history and context of a policy problem. As a candidate for post-normal science, waste management research needs to be grounded in context through *real* stakeholder involvement (Marshall and Farahbakhsh, 2013). Waltner-Toews et al., (2005) 'meta-narrative' approach to including perspectives of all relevant stakeholders – forming an understanding of "the constantly changing relationships among governance, decision-making power, and eco-social dynamics" (Marshall and Farahbakhsh, 2013, p. 998) – may be one way of developing a rich understanding of solid waste management systems. This sentiment aligns with a transdisciplinary approach to research taken in this dissertation.

### 1.3.5 Wicked problems

In this dissertation, I classify waste management as a *wicked problem*. In their foundational contribution, Rittel and Webber (1973) categorized public policy issues as 'tame' and 'wicked'. *Wicked* problems lack a clear definition; they are subject to multiple interpretations of the problem with multiple causes, interdependencies, conflicting goals, and trade-offs (Rittel and Weber, 1973). These problems can lead to unforeseen changes and consequences, unstable states and moving targets, with no clear or definitive resolution. Wicked problems are also socially complex with a range of stakeholders and no clear line of responsibility (person, discipline, or organization). Resolving wicked problems demands deep and significant changes in social behavior and institutional relations that guide behaviour; consequently, they are contextually grounded in place and time, often with those wanting to see change in the system being directly involved in the creation of the problem (Brown, 2010). This insight brings with it important implications for both governance and research (Brown, Deane, Harris, & Russell, 2010).

In governance systems, wicked problems require changes in governing structures that created the problems in the first place. Wicked problems affect the whole system in question; in practice, however, they are often treated as separate, tame problems that can be individually solved, an approach that leads to unanticipated, adverse consequences. Resolving wicked problems requires political and social will of decision-makers, consumers, and other actors who want to see change in the system, and who recognize that they are also directly involved in the creation of the problem (Brown, 2010).

In research, wicked problems require an approach that is intellectually different from previous ontological framings and epistemic traditions. It requires researchers to be open to all forms of inquiry and bases of knowledge (Brown, Harris, & Russell, 2010), fitting with a transdisciplinary approach to research taken by this dissertation and the multiple methods and sources of data discussed in Chapter 3. Framing waste management as a wicked problem draws attention to the gaps in existing waste management research to date, which has often focused on one aspect or problem at a time (e.g., transportation optimization, recycling efficiency) with presumed easy solutions (Chapter 2). Wicked problems do not respond to traditional, managerial approaches, and there is an ethical dilemma of treating wicked problems as tame ones: it ignores systems dynamics, relationships and the involvement of multi-scalar actors and governance structures.

The complexity and 'wicked' nature of waste management is particularly intensified for small island states given their inherent geographical limitations of space and separation by sea. Due to space constraints, islands are limited in their ability to absorb increasing accumulations of solid waste in landfills and dumpsites. Geographical separation (and in many cases, isolation) makes it difficult to outsource waste management processing activities (like recycling, incineration, and landfilling) to outside social-ecological systems. While islands continue to accumulate materials, primarily from imported goods, they lack the volume or economies of scale to implement the latest processing technologies that ameliorate accumulation challenges. Consequently, island waste management systems face a metabolic conundrum: too much accumulation for small system absorption, but not enough generation for economic viability of waste processing given current technology and return-on-investment wishes.

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## 1.4 Data access and transparency

The collection, access and use of data in small island states is limited. Throughout the research process I had the privilege of dedicated time that is not afforded to other professionals including Grenadian public servants and citizens. This dissertation aims to support public access to documentation, legislation, and data, as much as permitted through publishing agreements. Public files that support this dissertation are available in Google drive maintained by me and are linked throughout the dissertation: (https://drive.google.com/drive/folders/18eL3fGcP2JtUYJsK1apZVPgSEC4uw3p1).

## 1.5 Chapter conclusion

The tri-island state of Grenada was selected as a case study for this research. Grenada is challenged by a number of the same waste management problems experienced in other island states as reported in academic and grey literature. To date, waste management research (and for that matter, data) on waste management in the small island state of Grenada has been limited. This is the first comprehensive study of Grenada's waste management systems from a systematic, sustainability perspective. This dissertation's primary contribution is a systems-based, social-ecological analysis of Grenada's waste management system. The dissertation takes a transdisciplinary approach to research, and the chapters have been written with policy makers and change makers in mind.

To date, island waste management research, particularly in the interdisciplinary fields of Social Ecology and Industrial Ecology, has focused on the material aspects of understanding island waste management and sustainability. There has been very little attention paid to the socio-cultural factors that influence and drive the production of waste. In this respect, this dissertation makes a key contribution to the literature by looking at both the material and socio-cultural aspects of waste management in Grenada to provide a comprehensive, systems-based analysis of waste management as a problem within a social-ecological system.

The dissertation proceeds as follows. In Chapter 2, I review three sets of academic literature acquired through the Web of Science database: island metabolic research, island waste management research, and circular economy research. To address the gaps in the literature and conduct a system-based research program in Grenada, I design the study to use a robust set of mixed methods. Chapter 3 explains the methods used to operationalise the sociometabolic framework in Grenada's waste management system through a transdisciplinary research approach.

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To understand the social metabolism of waste in Grenada, it is important to first understand the material flows of waste as a 'baseline' to identify metabolic challenges (Moraga et al., 2019). While material flow accounting has been implemented in several islands (see review in Chapter 2), Chapter 4 presents the results of the first comprehensive material account of waste in Grenada. In Chapter 4, I address research questions, Q1: *What are the material flows of Grenada's waste management system?* and Q2: *What are the material flows of problematic materials like plastics, tyres, and motor oil?* This chapter makes a contextual contribution for policy makers to leverage in decision making. Additionally, this chapter makes an important methodological contribution to material flow accounting by expanding on Millette et al.'s (2019) work in demonstrating the utility of trade and waste characterisation data for MFA in data-poor environments. Following from the MFA, there is a need to further investigate *who* and *how* waste is generated in Grenada, and this is the focus of the subsequent Chapters 5 and 6.

Chapter 5 addresses the third research question, Q4: *What are the implications of governing systems of (institutions, legislation, and policy) and actors on the material flows of waste in Grenada?* This makes an important contribution to sociometabolism research by investigating the impacts and challenges that are mediated through (lack of) governance systems. Both the waste accounts in Chapter 4 and governance analysis in Chapter 5 illuminate governance gaps in relation to implementation and enforcement of existing laws and loopholes in import (inflow) controls.

Chapter 6 looks at the waste management system from the perspective of citizens participants, asking Q4: *From a citizen's perspective, what are challenges in an island waste management system?* Citizens are important contributors to the waste management system, yet research often overlooks the value of their perspectives in designing waste management systems that work. Furthermore, citizen consultation to date in Grenada has been largely absent or insubstantial. This chapter makes an important contextual contribution by illustrating what can be gained from a more robust, national consultation.

Chapter 7 collates the three results chapters and draws on them to recommend ways forward for improved, sustainable waste management in Grenada. In this chapter, I suggest that Grenada could move forward with an island appropriate, circular economy, and suggest future avenues for waste management and social metabolic research.

This dissertation makes a key contribution to the literature by looking at both the material and socio-cultural aspects of waste management in Grenada to provide a comprehensive, systems-based analysis of waste management as a problem within a social-ecological system.

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# Chapter 2 Literature Review

The purpose of Chapter 2 is to establish foundational knowledge on island sociometabolism and island waste management research, which forms the basis for investigating resource management and waste management in Grenada in a systematic way. I begin the chapter by exploring the merits of sociometabolic research in an island context (Section 2.1), which has been used to identify sociometabolic risk of islands. Due to their nature as well as exposure to other social-ecological systems, islands experience sociometabolic risk associated with waste generation. Island waste management research literature is reviewed in Section 2.2. Furthermore, I felt that it was pertinent to briefly review literature on the circular economy (CE), an emerging topic in waste management, resource management, social ecology, and industrial ecology literature (Section 2.3). CE is one possible approach to systematically addressing waste management challenges on islands; while there are certainly other approaches that could stand alone or be embedded in CE (such as, nature-based solutions (NBS) and cradle-to-cradle), CE was selected as a topic due to its emergence and popularity in both academia and application. Articles from each set of literature were selected systematically using a key word search and citation analysis. The method for selecting literature is included in Appendix 1, and the corpuses (i.e., list of articles included in the review) as well as citation network graphs are included in Appendices 2-4.

In the penultimate section of this chapter, I review the importance of public participation in waste management research and implementation; this section emphasizes the importance of the public in ensuring the legitimacy and sustainability of waste management governance. This topic is directly relevant to Chapter 6, and forms an important foundation for this dissertation.

## 2.1 Island sociometabolism and sociometabolic risk

Insular systems have been recognized for their "methodological utility" (Chertow et al., 2020, p. 2) in the field of industrial ecology and social ecology due to decisive geographical boundaries, limited entry/exit points, and, in comparison to larger continental systems, a manageable level of social, technical, and political complexity (Deschenes and Chertow, 2004; Eckelman et al., 2014). While pragmatic for research, islands also represent sites of potential *sociometabolic risk*, in which resource use (i.e., both stocks and flows) are maladaptive and can trigger a 'tipping point' or sociometabolic collapse (Singh, 2020; Singh et al., 2020). Busch and Sakhel (2016) describe self-sufficiency of island systems. *Self-consuming autarky* is a system where resources are used until their supply erodes in

absence of functional governance structures that balance resource consumption. *Self-preserving autarky* describes a strong sustainability situation where resources are used in ways that they can renew in perpetuity. The authors suggest that "island logic" of self-preserving, self-sufficient systems can be scaled up to larger, social-ecological systems, if the scale and complexity of the systems are small enough to manage (Busch and Sakhel, 2016). While *sociometabolic risk* has only recently been used to describe maladaptive social metabolism, island sociometabolic research has been illustrating both maladaptive and self-preserving material relationship for at least three decades.

Several authors in the island metabolism corpus (Appendix 1) have quantified island-wide material flows; these studies use material flow accounting to quantify metabolic indicators within the 'natural sphere' of the social metabolism conceptual framework (Figure 1.1). The first island sociometabolism research, according to Singh (2020a), investigated material and energy flows of Nämdö, Sweden; this research demonstrated island dependency on outside social-ecological systems for materials and energy, as the island was not self-sufficient in its primary production (Sundkvist et al., 1999). Singh et al.'s (2001) seminal contribution documented and calculated a shifting metabolic profile from a primarily subsistent society on Trinket Island in the Nicobar Islands. Through exposure to global social-ecological systems, the research results illustrate changing land use, consumption patterns and increase reliance on imported foodstuff (Singh et al., 2001). The sociometabolic system was permanently changed through a devastating hurricane and the subsequent (problematic) aid that followed to 'help' the Nicobarese recover (Singh, 2020; Singh and Haas, 2016). Qualitatively, the research suggested that there are significant impacts in waste generation, due to the influx of non-biotic, non-decomposable materials; lack of a formal waste management system made outflow calculations outside the scope of this research (Singh et al., 2001).

In Oahu, researchers use island-wide material accounts to quantify import dependency and waste generation on the island (Eckelman and Chertow, 2009). The island relies on imports for most materials; furthermore, the landfill is at capacity, and therefore, the island exports waste to mainland USA. The researchers recommend increasing import substitution, waste management enhancement through recycling, reuse, and other resource circularity opportunities, and finally, looking at legislative drivers, such as material standards, that limit material reuse on the island (Eckelman and Chertow, 2009). Krausmann et al. (2014) conducted a material flow account of two small island, resource-dependent economies, Trinidad and Tobago and Iceland. Both island economies are reliant extractive industries for a few materials to drive their economies; as a result, there is a reliance on

imports to meet their basic needs and consumption preferences, and a have a high domestic material consumption due primarily to waste flows from extractive industries. This demonstrates sociometabolic risk due to a reliance on trade to meet basic needs, as well as accumulation of waste materials.

### 2.1.1 Material stocks and impact on waste

Most island sociometabolic research to date has focused on the material flows; inflow and outflow research dominates the literature identified in the corpus. Recent publications have recognized the importance of material stocks for their contributions to construction and demolition waste, their resiliency to sea-level rise, climate change and hurricanes, and the importance of service delivery, like tourism and housing. In Grenada, Symmes et al., (2019) analyze the vulnerability of building stocks to impacts of extreme weather and sea-level rise using geographic information systems (GIS) and material stock accounting by building type. Similarly, in Antigua and Barbuda, Bradshaw et al. (2020) take a 'stock-flow-service nexus approach' to investigate the vulnerability of tourism material stocks using MFA and GIS. The results indicate that hotels and other stocks associated with tourist services are disproportionately vulnerable to sea-level rise due to their coastal locale (Bradshaw et al., 2020). The authors suggest that accounting for material stocks necessitates a broader conversation of *who* benefits from services derived, and how to foster resilience and inclusive development (Bradshaw et al., 2020).

Merschroth et al., (2020) quantifies the amount of building materials that will be rendered unusable in future sea-level rise scenarios, and therefore become future construction waste. The authors suggest adaptations including planned relocation, increasing use of sustainable building materials instead of concrete, and developing infrastructure, policies and legislation that promote and mandate the reuse, recycling, and energy recovery of materials (Merschroth et al., 2020). While other stock assessments are 'future casting' based on climate change and sea-level rise scenarios, Popescu et al., (2020) investigates the impact of Hurricane Irma on the stocks and circulation of waste flows on Saint Martin; the authors hypothesize that the 2017 hurricane season had a lasting impact on the Caribbean island's metabolism including waste flows.

### 2.1.2 Importance of field work and data quality in MFA

In some cases, metabolic studies on island require methodological flexibility and adaptation in the field, beyond that envisioned in the social metabolism framework (Fischer-Kowalski and Weisz, 1999; Singh et al., 2010). Field work has traditionally played a role in island sociometabolism

research due to lack of national and sub-national data sets (Owens et al., 2011; Singh et al., 2001). Recent contributions have further demonstrated the importance of field work and observations to both access and contextualize any national or island collected data, and fill data gaps with estimates or non-published statistics (Bahers et al., 2020; Bogadóttir, 2020; Noll et al., 2019; Popescu et al., 2020). In conducting a material-flow account of the metal-mineral-energy nexus, Bahers et al., (2020) supplemented material-flow data from national statistics, with semi-structured interviews of industry stakeholders, which allowed the researchers to estimate 'wasted' resources that are not accounted for in export statistics and accumulate on the island. Similarly, Cecchin (2017), Noll et al. (2019), and Tamura and Fujie (2014) used expert interviews to cross-check estimates for material flow accounts.

This literature demonstrates that through biophysical research, researchers and policy makers can help to illuminate the biophysical challenges. As the saying goes, *you cannot manage what you cannot measure*. Therefore, these researchers largely assert that better quantitative data can illuminate material (un)sustainability and (pending) metabolic risk of a social-ecological system (Singh, 2020). Authors have advocated for adding MFA to local decision-makers' "toolboxes" to illuminate local development challenges that include relying on imports, over-extracting of the limited natural resources, and increasing outflow (e.g., wastewater, solid waste, air pollution) (Cecchin, 2017).

### 2.1.3 Accounting for institutional and socio-cultural aspects – a key research gap

Understanding material stock and flow patterns can lead to better policy and regulatory choices, and motivate societal/behavioral change, *if* research and insights are cognizant of the socio-cultural sphere in the conceptual framework (Figure 1.1). Based on material flow accounting studies, researchers have suggested increased material self-sufficiency, decreased demands for imported materials, and increased cycling of existing materials to meet current islanders needs. A key gap in the literature, however, is the reliance on quantitative metrics to elucidate sociometabolic challenges, while ignoring the social, cultural, and governance issues that prevent action and transitions within the sociometabolic profile (Figure 1.1).

There is growing acknowledgement of a research gap addressing the social-cultural sphere (Figure 1.1), with recent contributions engaging in transdisciplinary, qualitative or mixed method research. Notably, this research includes island living labs or 'schools' that combine course work with transdisciplinary studies, institutional analysis, and citizen engagement and participation. The recent

special issue on Island Metabolism makes several contributions to this research gap (Singh et al., 2020).

Long-term research on the Greek island of Samothoraki has demonstrated the importance of transdisciplinary approaches, and incorporating information from political, legal, social, and cultural perspectives (Fischer-Kowalski et al., 2020; Noll et al., 2020, 2019). Fischer-Kowalski et al. (2020) synthesize the biophysical results of a decade-long transdisciplinary sociometabolic research project and discussed how the socio-cultural sphere impacts future sustainability pathways. This research demonstrates the complexity of sociometabolic research, particularly when investigating and discerning between supporting and conflicting social, cultural, and governance explanations for biophysical flows and stock generation. The authors assert that a collaborative process is essential for transitioning to more sustainable sociometabolic system and ameliorating sociometabolic risk in sectors like agriculture (Fischer-Kowalski et al., 2020; Noll et al., 2020).

In the Seychelles, a course-based research project on waste management was conducted using a 'transdisciplinary case study' method; this method employed students to conduct a set of projects identifying the challenges of waste management, including material-flow accounting of waste, institutional and legal framework analysis, consumer perspectives on waste and understanding material disposal and cycling potentials (i.e., recycling, biogas) (Meylan et al., 2018). This research demonstrates the value of systematic investigation from a multi-disciplinary perspective and highlights the importance of government-lead technical advice for implementing waste management of a variety of materials. Additionally, the authors assert the importance of understanding household behaviour and promoting source separating of materials linked with post-sorting activities, like recycling and energy recovery (Meylan et al., 2018).

Particularly poignant for this dissertation is a recent contribution from Shah et al., (2019), who demonstrates that islands are limited in their ability to absorb waste flows, like plastic from packaging associated with imports. This contribution qualitatively assesses the operators of governance – namely, institutions – in the plastic metabolism of the small island state. In this dissertation, I define *governance* as the setting, application and enforcement of the rules of the game (Kjaer, 2004). Key to governance is the concept of *legitimacy*, as it ensures stability of the governing structures, and is derived through both democracy and efficiency (Kjaer, 2004).

Institutions are a means of governing (i.e., the social structures, activities and resources that reinforce the rules of the game). I would further suggest that institutions are a means of reinforcing

legitimacy or illegitimacy; in other words, some institutions will be viewed as effective at governing, while others may not, based on one's perspective. Leveraging work from Scott (1995), Shah et al., (2019, pg. 4)[3] define institutions as follows:

> *Institutions are social structures that have attained a high degree of resilience. [They] are composed of cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life. Institutions are transmitted by various types of carriers, including symbolic systems, relational systems, routines, and artifacts. Institutions operate at different levels of jurisdiction, from the world system to localized interpersonal relationships. Institutions by definition connote stability but are subject to change processes, both incremental and discontinuous.*

More simply, Scott (2013, pg. 57) uses this 'omnibus' definition:

> *Institutions comprise regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life.*

Unpacking both of these related definitions, Shah et al., (2019) describes waste management policies, decisions, and actions through the lens of three institutional forces, as suggested by Scott's work: coercive or regulatory, normative, and cultural and cognitive drivers (Table 2.1). These drivers align with key themes that emerge in my dissertation (Chapter 5, 6).

First, coercive, regulatory forces provide institutions with authority to establish rules, laws and regulations and assign responsibilities. Notably, as the case in Grenada (Chapter 5), islands have a number of enacted laws and regulations governing waste management, yet enforcement (i.e., the capacity to enforce) is lacking (Mohee et al., 2015). Second, normative drivers center around shared beliefs about "appropriate behavior" in society, and are established and reinforce through communication from community, activist, and business groups. Lastly, cultural, and cognitive drivers focuses on a shared understanding, recognizing beliefs, mental models, and interpretations of shared meaning. Furthermore, this perspective stresses that sustained changes in behavior are both internalized and culturally supported. From a waste perspective, this points to the importance of

[3] I was unable to access copies of Scott (1995) and therefore unable to verify the page numbers of the original definition from Scott, as quoted by Shat et al., (2019).

changing attitudes, beliefs, awareness and concerns about waste generation, collection, and disposal techniques.

Lenzen (2008) and Bogadóttir (2020) suggests that island sustainability research often focuses on technological fixes with modernity and growth-based ideologies; they argue that research lacks the cultural dimensions of sustainability inherent within *living on an island*. This aligns with previously discussed cultural-cognitive institutional drivers. In their research, Bogadóttir (2020) explore the 'quiet sustainability' practices in the Faroe Islands, and their contribution to the sociometabolism of the island, suggesting a more nuance, culturally embedded approach to sociometabolic research. The research suggests that islanders are already nurturing, conserving, and remembering culturally specific economic practices to counter the consequences of mainstreamed 'development'. In Norfolk Island, Lenzen (2008) suggests that island social-ecological systems have a history of failed technology implementation; using two businesses as case studies, the author demonstrates how vision and creativity can be used to reduce an islands metabolism. The authors assert that metabolism studies have value in illustrating the 'magnitude' of resource use, suggesting that island communities need to live within the capacity of the island (Lenzen, 2008). In other words, moving away from a sociometabolic risk society to one of self-preservation and sufficiency (Busch and Sakhel, 2016).

| | **Regulatory** | **Normative** | **Cultural-Cognitive** |
|---|---|---|---|
| *Basis of compliance* | Expedience | Social obligation | Shared understanding |
| *Basis of order* | Regulatory rules | Binding expectations | Constitutive schema |
| *Mechanisms* | Coercive | Normative | Mimetic |
| *Logic* | Instrumentality | Appropriateness | Orthodoxy |
| *Indicators* | Rules, laws, sanctions | Certification, accreditation | Common beliefs, shared logics of action |
| *Affect* | Fear, guilt, innocence | Shame, honor | Certainty, confusion |
| *Basis of legitimacy* | Legally sanctioned | Morally governed | Comprehensible, recognizable, culturally supported |

Table 2.1 Three institutional forces, adapted from Scott (2013) and Shah et al., (2019).

Institutional and cultural contributions in sociometabolic research (Bogadóttir, 2020, Lenzen, 2008, Shah et al., 2019) reaches beyond traditional, quantitative approaches assessing the 'Natural' sphere in the social metabolism conceptual framework (Figure 1.1). They are key contributions to

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sociometabolism literature, demonstrating the role that institutions play in guiding waste flows, and establishing (or ameliorating) metabolic risk. The literature demonstrates that there is an opportunity for islands to re-think their sociometabolism; techology can play a role, however *only* if it is appropriate for the conditions, and serves the sociometabolic needs and constraints of the island communities. Ultimately, governing waste management is reliant on a set of institutional elements – e.g., regulations, normative expectations, and cultural mental models – that steer (or do not steer) the waste management system. The elements of institutions draw attention to a range of issues that are directly relevant to challenges associated with waste management on islands, including gaps in legislation, regulatory frameworks, data and information needs, the role of private sector and non-governmental organizations, and cultural-cognitive model that drive behaviour and social practices. The next section reviews island waste management literature, discussing how this research contributes to understanding waste management challenges including sociometabolic risk and the gaps that remain in fully understanding an island waste management system.

## 2.2 Island waste management as sociometabolic risk

While islands vary in their social, cultural, economic, and environmental attributes, they share a defining characteristic of being physically separated from other landmasses and surrounded by water (Eckelman et al., 2014). From a sociometabolic perspective, island waste management systems experience challenges related to the inputs of waste from outside social-ecological systems (i.e., imports or marine litter), production of waste from industrial manufacturing, and the accumulation of materials on an island due to limited opportunities for exports. Islands are limited in their ability to safely absorb waste within their social, environmental, and economic carrying capacity. The generation of waste, the diversity of waste, and amount of waste are all pressures that affect the state of the biotic and built environment (e.g., landfills) of a small island state, and increase an islands sociometabolic risk. This section reviews a number of characteristics of waste management on small islands directly relevant to the topic of this dissertation.

Several contributions to island sociometabolic studies have looked at waste management specifically. In Malta, Camilleri-Fenech et al. (2017) use material flow accounting and carbon footprint to assess the sustainability impacts of the waste management system. This research demonstrates the value of accounting for material flows in the waste management system and suggests that sorting materials is a critical step is realizing the material potential of non-homogenous waste (Camilleri-Fenech et al., 2017). Owens et al., (2011) quantified waste accumulation through household waste collection and

segregation and marine litter surveys. Marine litter equated to 57% of the total waste inputs from the island; this clearly illustrates the impact that global waste management practices have on small island states, creating sociometabolic risk outside of islanders' control. Additionally, the researchers observed a shift in consumption patterns with increased prevalence of packaged food, leading to additional household waste (Owens et al., 2011).

Several island metabolic studies have focused on specific problematic waste materials that are accumulating in island environments, such as end-of-life vehicles (Lin et al., 2018), tyres (Sarkar et al., 2011), e-waste (Mohammadi et al., 2021) and plastics and marine litter (Millette et al., 2019; Owens et al., 2011; Shah et al., 2019). These materials represent a significant outflow challenge for small island social-ecological systems and create sociometabolic risk in terms of threats to both environmental and human systems.

The disposal of scrap tyres has become one of the largest solid waste management issues in SIDS, with 80,000 tyres being stockpiled in Dominica alone, with many more littering the island (Sarkar et al., 2011). Used tyre stocks pose many health challenges, but reuse and/or proper disposal is challenged by poor economies of scale on the island[4]. Subsequently, Caribbean islands are incinerating/burning, landfilling, and stockpiling (sometimes illegally in the environment), resulting in the accumulation of a material stock that is an environmental, health and economic concern for the island (Sarkar et al., 2011)

Like many island jurisdictions, Kinmen, Taiwan has a sustainability and aesthetic problem associated with abandoned end-of-life vehicles (Lin et al., 2018). Researchers found that the island currently lacks capacity to dismantle and treat future end-of-life vehicle stock. Based on the material flow results, the researchers suggest that increasing the profitability of certified dismantling businesses and shipping vehicles off island to help prevent the abandonment of vehicles (Lin et al., 2018).

Plastics have become a particularly problematic waste management issue for islands, with two contributions investigating the sociometabolism of plastics in Trinidad and Tobago (Millette et al., 2019; Shah et al., 2019). Millette et al., (2019) quantifies plastic waste using a novel approach to material flow accounting combining trade data with a waste characterisation study that is leveraged

[4] A stock of scrap tyres poses a risk to public health through presenting a breeding ground for another undesirable stock disease-carrying mosquito as well as a fire hazard. Likewise, outflows of tyres as waste are difficult due to difficulty of find a willing recipient as well as the cost of transportation. Reusing tyres may also be cost prohibitive due to economies of scale or the capital investment required for infrastructure to process the waste

in this dissertation (see Section 3.2). The authors suggest a number of strategies to promote a circular plastic economy: banning polystyrene, engaging in PET recycling, using LDPE plastics in waste-to-energy, and further enhancing the results of the study through construction and demolition waste characterisation (Millette et al., 2019).

Broadly speaking, waste generation rates on islands are higher than other social-ecological systems. Mohee et al., (2015) compiled waste generation rates across small island state geographical regions (Figure 2.1A). The authors speculated that Caribbean per capita generation rates are higher than other SIDS due to standards of living, economic growth, and tourism. The authors present waste composition by geographical areas, noting that organic waste makes up a significant portion of waste composition in small island states. In the Caribbean, 46% of MSW is biodegradable waste (Figure 2.1B); the authors suggest that this high percentage is due to the tendency to purchase whole food compared to ready-made items in packaging (Mohee et al., 2015).

Waste composition and generation data plays an important role in deciding the appropriate means of processing and disposing of waste (Mohee et al., 2015), but this can be challenging, particularly when waste is collected co-mingled or weighbridges do not exist (Gidarakos et al., 2006). Island waste management is hampered by an absence of data collection (Fuldauer et al., 2019). While separating and collecting recyclables is viewed integral to small island waste management (Mateu-Sbert et al., 2013), many islands lack source separation and diversion of materials (Bai and Sutanto, 2002; Estay-Ossandon et al., 2018; Jones et al., 2010; Owens et al., 2011; Sealey and Smith, 2014; Tavares et al., 2009). Consequently, waste characterisation is of utmost importance and forms a critical baseline before implementing any waste management disposal or processing options (Eckelman et al., 2014; Eckelman and Chertow, 2009; Owens et al., 2011). Waste managers and decision makers need to be aware of the metabolic preferences and flows of an island in order to respond to changing quantities and complexities of the waste stream (Georges, 2006).

Economic growth is envisioned and sought after by island governments as a primary response for delivering prosperity and basic needs like food, shelter, health, and security. The literature identifies economic growth, particularly growth in the tourism sector, as a key driver in waste generation and other environmental pressures (Bai and Sutanto, 2002; Fuldauer et al., 2019; Mohee et al., 2015). A number of authors investigate the impact of tourism on waste management in small islands (Chen et al., 2005; Eckelman and Chertow, 2009; Estay-Ossandon and Mena-Nieto, 2018; Fuldauer et al., 2019; Gidarakos et al., 2006; Kasavan et al., 2019; Mateu-Sbert et al., 2013; Sealey and Smith, 2014;

Zsigraiová et al., 2009). For example, on Menorca Island, researchers estimated of the impact of tourism waste using a dynamic regression model. Results indicate that tourists generate 1.31 kilograms of waste per day, in comparison to 1.48 kilograms of waste per day for residence (Mateu-Sbert et al., 2013). Several authors identified environmental costs of tourism growth, including the development of 'trash islands' in the Maldives to accommodate resort-island tourism (Domroes, 2001; Kapmeier and Gonçalves, 2018). The conundrum for island dependent on tourism is that the very garbage generated by tourists and tourism expansion decreases the attractiveness of the island (Kapmeier and Gonçalves, 2018), therefore representing both a sociometabolic and economic problem in which islands need to decide *how much tourism is enough*.

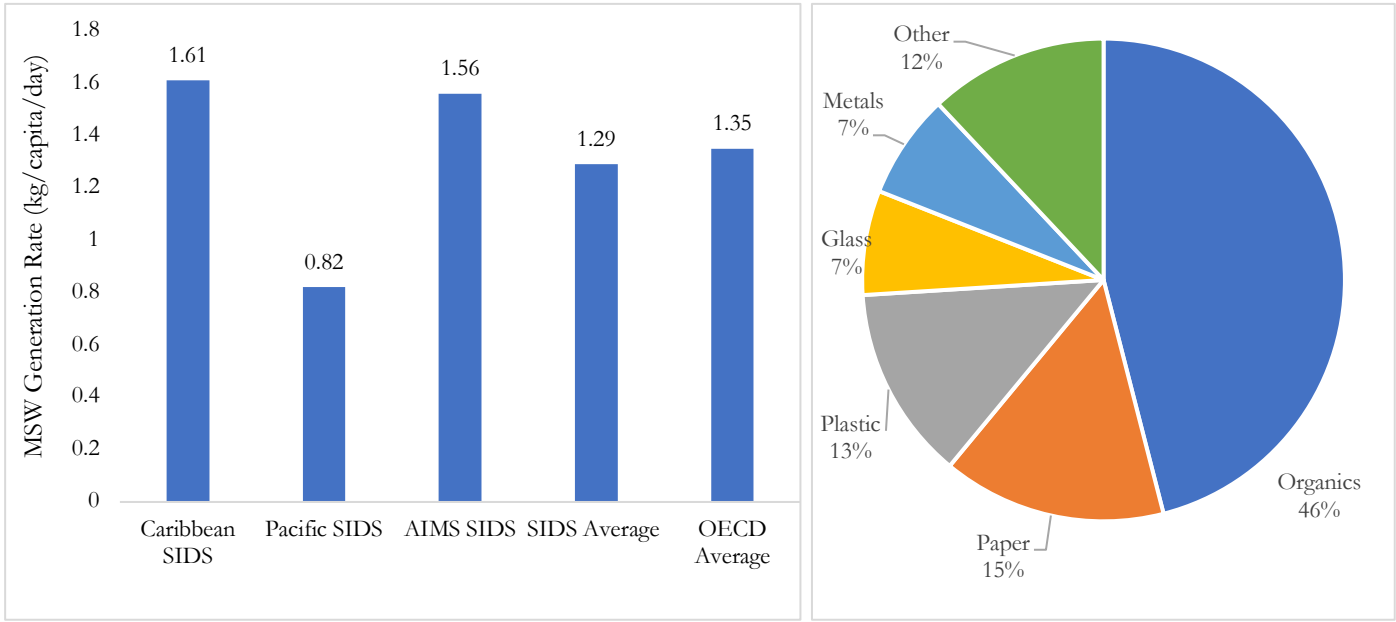


Figure 2.1 Select waste management statistics, compiled by Mohee et al., (2015)
A) MSW Generation rate B) Waste composition in the Caribbean

Islands have become reliant on imported goods to meet citizen and tourist needs; this presents a sociometabolic and waste management problem, based on an increase in packaging and non-biodegradable materials in waste composition (Bai and Sutanto, 2002; Chen et al., 2005; Estay-Ossandon and Mena-Nieto, 2018; Owens et al., 2011; Zsigraiová et al., 2009), as well as loss of resiliency and self-reliance, and living within the capacity of the island (Eckelman and Chertow, 2009; Lenzen, 2008). Noting the importance of up-to-date data on waste composition, Gidarakos et al., (2006) characterised municipal waste on the island of Crete over the course of a year (i.e., all seasons). The researchers note that tourism activity, industrial greenhouses and changes in consumption patterns has increased the composition of non-putrescible waste (e.g., plastic, paper, and glass). Comparing the results to Greece's national solid waste plan, the authors noted the differences in composition, further asserting the value of contextualised research. The implications of increased waste generation from economic growth, tourism expansion, and changes in consumption are discussed in the literature – but there is limited discussion about how to respond to these the 'root causes' of waste generation (Lenzen, 2008).

Waste generation, diversity of materials and the characteristics of island geographies limit an island's ability to absorb waste. The literature indicates that islands tend to rely on degraded or poorly sited landfills and dumpsites as the primary means of disposal of waste (Kontos et al., 2003; Mohee et al., 2015; Sealey and Smith, 2014; Skordilis, 2004; Tavares et al., 2009; Zsigraiová et al., 2009). These landfills and dumpsites lack engineering technologies, such as leachate management, methane gas management, and covering to prevent dispersal of materials and smells (Eckelman et al., 2014; Mohee et al., 2015), resulting in materials becoming pollutants to the environment. As many islands have a mountainous topography, with populations, tourism infrastructure and building stocks occupying coastal areas (Bradshaw et al., 2020; Symmes et al., 2019), access to suitable land for waste management activities is a challenge. Not-in-my-backyard (NIMBYism) further exacerbates land space issues (Eckelman et al., 2014; Ramjeawon and Beerachee, 2008). In some cases, dumpsites were traditionally sited on mangroves or coastal swamps, as this land was seen as not 'valuable' (Eckelman et al., 2014). Competition for land space is evident in the corpus, with a number of articles concerned with siting of waste management infrastructure (Kontos et al., 2005, 2003; Ramjeawon and Beerachee, 2008; Tavares et al., 2011).

To date, there is limited infrastructure for waste diversion, like recycling and composting on islands (Bai and Sutanto, 2002; Camilleri-Fenech et al., 2018; Estay-Ossandon et al., 2018; Mohee et al.,

2015; Owens et al., 2011; Sealey and Smith, 2014). Furthermore, sorting waste, either at the household or sector level is not widely practiced (Estay-Ossandon et al., 2018; Jones et al., 2010), and most islands deposit waste co-mingled. Mohee et al., (2015) suggest several reasons why recycling is not practiced in island waste management systems (Box 2.1) based on economic, environmental, and social circumstances.

- Low level of awareness and sensitization.
- Types of pre collection undertaken (curbside, drop off)
- Pre-processing methods involved.
- Low government subsidies
- Non-governmental organisations participation.
- Scrap value of the recyclables.
- Quantity of the recyclables available.

Box 2.1 Factors hindering recycling in small islands (Mohee et al., 2015)

Island waste management infrastructure has not kept pace with waste management generation (both quantity and composition), and there is a significant accumulation of waste in either landfills or open dumpsites. For example, Foolmaun et al., (2011) found that the changing composition and accelerating quantities of waste being generated on the island of Mauritius was no longer compatible with existing landfilling strategies, yet citizens opposed further landfill development due to limited land space. Other islands rely on external social-ecological systems to accept their waste (Eckelman and Chertow, 2009), but this option is not available to all islands and may be limited to sub-national jurisdictions (Kapmeier and Gonçalves, 2018).

Small island states tend to have small economies and a relatively small amount of waste material generation, making it financially challenging to implement waste management solutions designed for bigger markets (Eckelman et al., 2014). In addition to insufficient funds, Mohee et al., (2015) suggest that waste management is not prioritized in small island government budgets (e.g., Morrison and Munro, 1999).

There are long-term remediation costs associated with poor waste disposal practices. On several islands, researchers indicated that polluters were not necessarily paying a fair price for waste management services. For example, waste generators and haulers were not paying tipping fees for the dumpsites in Exuma, Bahamas (Sealey and Smith, 2014); lack of tipping has been noted in other Caribbean islands, like Tortola (Georges, 2006). In contrast, Eckelman et al., (2014) indicated that

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some islands, like Oahu, have high tipping fees due to the high operational costs of waste management (e.g., fuel costs, land costs). In Singapore, waste disposal fees have increased to eliminate subsidizing and stifling of the waste recycling and recovery industry (Bai and Sutanto, 2002). This suggests that waste management should have an economic cost to reflect the sociometabolic risk and reflect the actual cost of waste management on an island, as well as to motivate behaviour for more diversion opportunities.

### 2.2.1 Treating waste management on islands as a 'tame' problem

Considering the numerous challenges with island waste management, researchers to date have focused on optimizing waste management decisions by creating decisions support models through 'future-casting' waste management collection and disposal options. This literature focuses on 'end-of-pipe' (i.e., collection, processing, and disposal) solutions to address the environmental and economic pressures created by growth in waste generation. Notably, this research treats these problems as 'tame' problems to be rationalize, economized, and solve, using various parameters. It does not acknowledge or address the root causes of the problems, such as questioning the merits of economic growth-based development (Lenzen, 2008). For example, a number of authors anaylse waste processing and disposal options based on econonmmic costs based on future generation (Chen et al., 2005), and environmental impacts using life-cycle analysis (Khoo et al., 2010; Rajcoomar and Ramjeawon, 2017; Tan and Khoo, 2006). Using Corfu as an example, Skordilis (2004) combines worth benefit utility analysis with life cycle analysis to incorporates subjective opinions into the decision-making process; while this study illustrates the value of social parameters, it is largely decontextualized as it does not account for opinions outside of a select group of experts, or the current governance structures on the island of Corfu in their assessment.

Other authors in the corpus investigate how waste management can be further optimized in terms of energy use, waste disposal and waste collection. As islands generally lack energy sources and drinking water, researchers modelled an integrated waste management system that includes transportation optimisation, incineration for energy recovery, and drinking water production in Cape Verde (Zsigraiová et al., 2009). Tavares et al., (2009) used a 3D model to optimize transportation routes to improve fuel efficiency with waste collection in Santiago Island. Several researchers have investigated landfill and incineration siting using multi-criteria analysis as decision support tool. In the Greek islands, Lesvos and Lemnos Island in Greece, Kontos et al., (2005, 2003) used GIS and multi-criteria analysis to rank landfill sites. Similarly, in Mauritius, researchers ranked possible landfill

sites across three main criteria: environmental, socio-economical, and technical, and 21 sub-criteria (Ramjeawon and Beerachee, 2008). In Cape Verde, researchers extended the multi-criteria methodology to include environmental impacts assessment for incinerator siting (Tavares et al., 2011). Overall, this line of research in demonstrates the value and feasibility of transparent decision criteria and ranking; however, as noted by three researchers, the method does not account for politics and motivation by policy makers, nor community opposition in making these decisions (Kontos et al., 2003; Ramjeawon and Beerachee, 2008).

To ameliorate land competition, a number of island governments have opted to use incineration to reduce the amount of waste to be landfilled (Bai and Sutanto, 2002; Eckelman and Chertow, 2009), Siting incineration plant, however, brings with it their own set of political challenges and NIMBYism (Tavares et al., 2011) and ecotoxicity of pollutants( Tan and Khoo, 2006). While burning may extend the life cycle of the dumping area, create significant health and environmental concerns for the surrounding populations.

Other decision support models combine methods to account for the complexity of choices (including political and social) in waste management decision making. In the Canary Islands, Estay-Ossandon et al., (2018) combined interviews with MSW experts using the Delphi technique (i.e., an interview technique designed to gain consensus), the fuzzy TOPSIS technique to reduce the vagueness and uncertainty in qualitative judgements, and systems dynamics models to model the impacts with future waste generation. Su (2007) demonstrates the use of policy impact potential analysis to supplement multi-criteria decision making for more politically sound waste management decision making.

### 2.2.2 Social-cultural and governance issues in waste management – a key research gap

Overall, the island waste management literature demonstrates the importance of quantitative investigation in generating decision support tools for waste management. While some authors reflect on the importance institutional elements, like alignment between social behaviours and policy (Estay-Ossandon et al., 2018; Skordilis, 2004; Su et al., 2007), there is a gap in understanding the governing structures, including institutions, that result in waste management challenges on islands. Notably, when decision support research incorporates qualitative data, it is often only the perspective of "experts". This points to a large gap in failing to account for citizen's perspectives in waste management, leading to issues with legitimacy.

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Drawing from previously defined concepts of governance and institutions, island waste management systems experience institutional challenges related to lack of formal procedures, policies, strategies, and appropriate legislation and regulation to promote sound solid waste management (Mohee et al., 2015). Where such governing and institutional structures do exist, enforcement and awareness of regulation and legislation is limited, therefore, resulting in informal disposal like backyard burning and illegal dumping (Chen et al., 2005; Gidarakos et al., 2006; Jones et al., 2010; Owens et al., 2011). Sealey and Smith (2014) suggested that the public receives 'mixed messages' when communities pay residents for cleaning up the road side and illegal dumpsites, instead of fining the violators.

Researchers further suggests that there is an educational challenge related to waste management. For example, citizens are often not aware of the full costs of waste management (Sealey and Smith, 2014), which may explain why they do not fully participate with desired human behaviors (Bai and Sutanto, 2002; Fuldauer et al., 2019; Mohee et al., 2015), leading to shifting cultural-cognitive elements of waste management governance.

Sealey and Smith (2014) measured the outcomes of a food waste benchmarking study in Exuma, Bahamas. The study illustrated the importance of a multi-stakeholder approach that include regulatory measures to motivate hotels and resorts to engage in waste management activities. In other words, hotels are not necessarily motivated intrinsically (from a normative perspective) to improve their sociometabolism.

There is relatively little research that addresses human behaviour, and the influence of governing and institutional factors like social connection and trust, trust in institutions, environmental awareness, policy, and regulatory mechanisms. Jones et al., (2010) investigated the social factors that influence Lesvos Island citizens' perceptions and willingness to pay for waste management services via negative economic incentives. The researchers found that many citizens were not willing to comply or pay for waste management services; however, social trust and social capital played a statistically significant role in the outcomes of the environmental policy. Consequently, the authors suggested that economic costs for waste should be accompanied by building social trust through community participation in cleanliness, and citizen involvement in decision making and policy making. The creation of neighbourhood networks and establishing waste management schemes using citizens and state actors may be one way to engage citizens (Jones et al., 2010).

Disposal through landfills and dumpsites defers the costs to future governments and citizens, who will be required to remediate the sites to protect human and environmental health (Meylan et al.,

2018), but the literature in the corpus does not address this environmental injustice. The long-term environmental and human costs of poor waste disposal (i.e., open dumpsites, littering and dumping) are "seldom considered" by island governments (Sealey and Smith, 2014, p. 31), and this is evident in the lack of literature addressing the environmental and human health impacts and related economic impacts. For example, improper landfill siting, design, construction and operation results in pollution to the air, soil, ground water and marine environments (Kontos et al., 2003). Logically, it is expected that the pollution is even greater if waste is disposed in open dumpsites that lack gas and leachate control measures, which are frequently used for disposal on islands. These impacts have serious consequences for neighbouring communities, yet are not widley investigated in the literature. As demonstrated above, researchers model probable environmental impacts of waste management options, yet none of the research investigate pollution outflows from an existing dumpsite/landfill or decommissioned waste disposal site (Nolasco et al., 2008).

The environmental impacts of waste generation need to be considered in the development plans particularly tourism plans, for a small island state. In Bahamas, environmental impact assessments are used to approve hotel development, but ongoing environmental impacts are not monitored and mitigated after the initial development phase (Sealey and Smith, 2014). Consequently, monitoring environmental and human impacts are integral to mitigating long-term implications from poor waste management systems.

The technicalities or management practices of how to collect, process and dispose of waste on islands is an important line of research in the literature to date; this research forms a valuable set of tools of how to evaluate the 'end-of-pipe' options. But the complexity of waste - illustrated by drivers, human behaviour pressures, changes in the environmental and human state, and impacts of poor waste management - necessitates further research on how to address the root causes of waste generation and governance and institutional elements that steer island waste metabolism.

Islands are accumulating problematic materials with little means to dealing with the waste. The island waste management literature demonstrates that contributions from the fields of industrial ecology, planning, and engineering with future-casting modelling of waste management challenges. Optimization of "end-of-pipe" solutions (i.e., collection, processing, and disposal) forms most of the research. Arguably, however, by treating island waste management as a tame problem to be optimized, researchers are limiting the scope and impact that their research can contribute to waste governance. A key gap in the literature therefore is recognizing the complexity of waste management

through understanding how the *rules of the game* play out through institutional elements like regulation, normative ideas, and cultural behaviours. All of these social-cultural issues within the sociometabolic framework impact waste management on an island. This has led me, as a researcher, to seek out rich contextual data and knowledge of *what works* in a particular island context.

## 2.3 Circular economy

The circular economy (CE) is emerging as a popular concept in resource management, waste management and sustainability. Applied systematically, it may be an approach to address waste management and sociometabolic risk in small island states. CE is often contrasted against and positioned as a potential solution to the current *linear* economy. From a sociometabolic perspective, in the current economy, natural capital is removed from the environment, converted into products or stocks, and ultimately becomes waste deposited in the environment or landfills at varying timescales. The circular economy offers alternatives beyond the 'end-of-pipe' solutions that are prioritized in the island waste management literature (Section 2.2).

The concept of a circular economy emerged from a set of seminal, interdisciplinary publications in sustainability and resource management (Murray et al., 2017; Prieto-Sandoval et al., 2018; Winans et al., 2017). Building from Boulding's (1966) 'Spaceman economy", industrial ecologists Pearce and Turner (1989) describe the economy as being defined by natural resources as both inputs for production and consumption and sinks for waste; they are often credited with the first authors to use the term 'circular economy'. Some key features of the circular economy like waste prevention, localized job creation, dematerialization and selling utilization or services, instead of goods were discussed by Stahel and Reday (1981) and Stahel (2010). The concept *cradle to cradle*, likened to the current 'butterfly diagram' popularized by the Ellen MacArthur Foundation, describes an economy working in loops, and materials remaining within either the biological or technical cycles (McDonough and Braungart, 2002) (Figure 2.2). All these works are cited within the corpus (Appendix 4) as being foundational to the development of the circular economy concept.

In the past two-decade publications on the circular economy have skyrocketed. As a result, several academic reviews have emerged to try to *make sense* of this new field, and what it means for the number of disciplines and inter-disciplines of study. Eleven of the 24 studies included in this review are 'review' articles that aim to answer research questions about the existing state of the literature (Table 2.2).

| Study | | Web of Science citations | Focus of the review |
|---|---|---|---|
| 1. | Ghisellini et al., (2016) | 1021 | Summary of 155 articles on CE. |
| 2. | Geissdoerfer et al., (2017) | 891 | Comparison of circular economy and sustainability. |
| 3. | Kirchherr et al. (2017) | 686 | Review of 114 definitions of the circular economy. |
| 4. | Tukker (2015) | 583 | Product-service systems review. |
| 5. | Lieder and Rashid (2016) | 522 | Summary of CE literature from the manufacturing industry. |
| 6. | Murray et al., (2017) | 390 | Comparison of circular economy and sustainability. |
| 7. | Lewandowski (2016) | 317 | Conceptualization of circular business models. |
| | Andersen (2007) | 228 | Circular economy and environmental economics. |
| 9. | Sauvé et al., (2016) | 217 | Comparison of the circular economy, environmental science and sustainable development. |
| 10. | Kalmykova et al., (2018) | 210 | Strategies and implementation database of circular economy across the value chain. |
| 11. | Blomsma and Brennan (2017) | 200 | Explanation of the emergence of the CE concept. |

Table 2.2 Reviews of the circular economy concept, adapted from Kirchherr et al., (2017).

Researchers have argued that the circular economy remains an elusive concept with various understandings. Review articles have grappled with how to define, conceptualize, and implement the circular economy based on its connection to concepts and frameworks in industrial ecology, ecological economics, sustainable development, sustainable business and supply chains, and sustainability science (Andersen, 2007; Bocken et al., 2016; Geissdoerfer et al., 2017; Ghisellini et al., 2016; Kirchherr et al., 2017; Lewandowski, 2016; Lieder and Rashid, 2016; Murray et al., 2017; Sauvé et al., 2016; Winans et al., 2017). From these reviews, no one definition of CE has emerged victorious, and researchers continue to debate how to conceptualize, define and measure what has been termed an *essentially contested concept* (Korhonen et al., 2018)[5]. Consequently, there is agreement in the literature on some key principles or goals of the circular economy - namely longevity of materials and hierarchy of strategies - yet there continues to be disagreement on how to define and what to measure in circular economy research (Kalmykova et al., 2018). Authors have suggested that there is need for conceptual clarity, otherwise the concept will either remain in a deadlock or collapse (Blomsma and Brennan, 2017; Bocken et al., 2016; Korhonen et al., 2018).

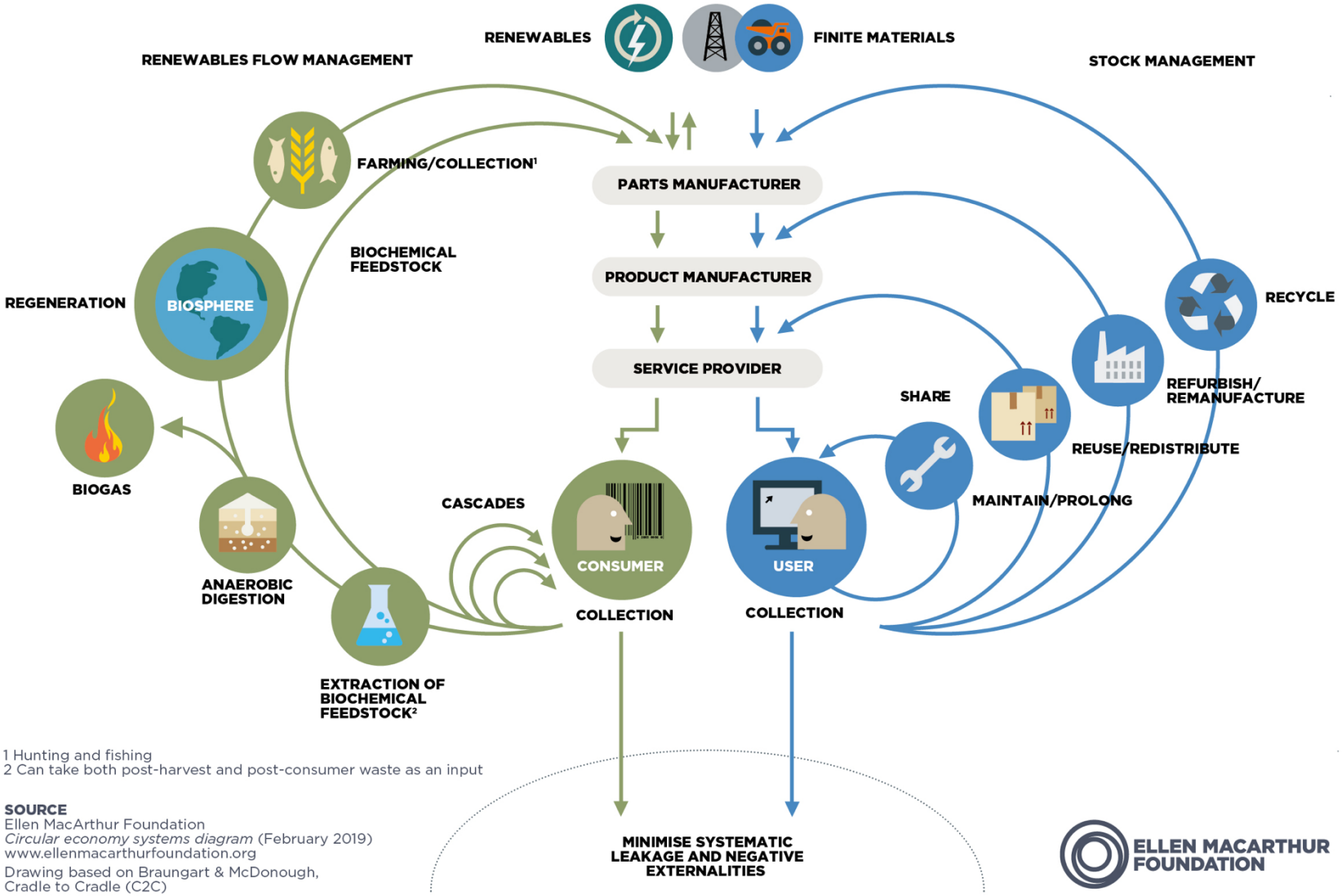


Figure 2.2 Butterfly diagram from Ellen MacArthur Foundation

### 2.3.1 Strategies for circularity

At the heart of the circular economy is an effort to 'close the loops' of production and consumption, facilitating longevity of materials remaining in a social-economic system. This has been referred to as resiliency of resources (Sauvé et al., 2016) and stock optimization (Kalmykova et al., 2018) in the literature. Economies can maintain resources in a socioeconomic system through a gamut of resource life-extending strategies (RLES) (Blomsma and Brennan, 2017) which ultimately reduce the amount of virgin materials extracted and waste materials released into the environment.

A number of resource-life extending strategies (RLES) have been proposed. Kalmykova et al. (2018) developed a database of RLES for implementing the circular economy across value-chains (e.g., material sourcing, design, manufacturing). Moraga et al., (2019) and Potting et al. (2018, 2016) identified five overarching sets of RLES for preserving products and materials. First, preserving, extending, and intensifying the **functionality** through sharing products and promoting product redundancy and multifunctionality. Second, preserving the **product** through improved durability, reusing, repairing, refurbishing, and remanufacturing. Third, preserving **parts or modules** of a product through repairing, refurbishing, and remanufacturing. Fourth, preserving **materials** through repurposing, recycling, and downcycling. Lastly, preserving **energy** by recovering through incineration and methane gas management in landfills. In addition to the five circular economy strategies, Moraga et al., (2019) stressed the importance of measuring the linear economy (e.g., deposits in landfills and dumpsites) for a reference scenario to demonstrate if RLES are helping to generate less waste per capita overtime. The strategies, including the 'baseline' reference scenario, are depicted in Figure 2.3.

For the circular economy to be realized, RLES must be implemented in hierarchy. This principle is exemplified through established waste management thinking, such as the 'waste hierarchy' and the colloquial 'reduce-reuse-recycle' (Sihvonen and Ritola, 2015). Various frameworks are outlined in the literature, ranging from the common 3-Rs ('reduce, reuse, recycle') to the 9-Rs conceptualized by Potting et al. (2016) and van Buren et al., (2016). This hierarchy is depicted on the right side of Figure 2.3. Despite the importance of hierarchy, research in the circular economy finds that hierarchies are often ignored in implementation; for example, actors claim implementation of the circular economy based on mediocre efforts to implement low preservation strategies (i.e., recycling, incineration) without considering the more-preferred RLES (i.e., preservation of functionality through sharing economies) (Kirchherr et al., 2017). Reviews indicated that recycling is the

dominant strategy being employed by researchers investigating the circular economy (Ghisellini et al., 2016; Kirchherr et al., 2017); therefore, claims of circularity may not be considering hierarchical implementation. Kirchherr et al., (2017) suggests that by explicating a waste hierarchy, the circular economy becomes less of a 'feel-good' concept that *everyone* can employ, because it becomes more prescriptive. However, explicitly indicating a hierarchy is important for guiding implementation (Murray et al., 2017).

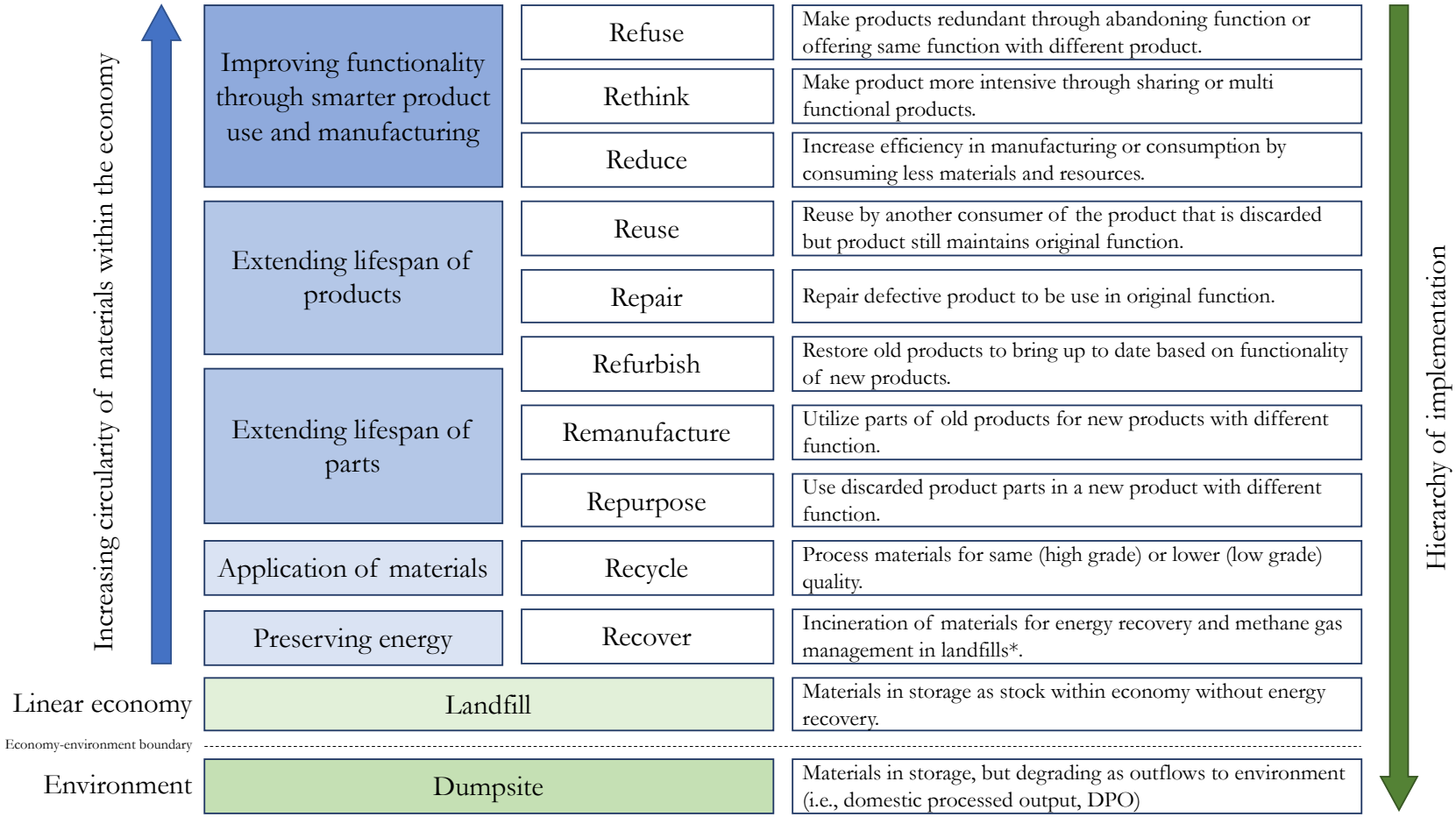


Figure 2.3 Resource-life extending strategies in the circular economy.
Adapted from Potting et al. (2016). *Incineration is not considered a circular economy strategy by some organizations

In line with the Ellen MacArthur Foundation and the cradle-to-cradle concept (McDonough and Braungart, 2002), Murray et al., (2017) suggests that a critical feature of a circular economy is the separation of biological/biochemical nutrients and technical nutrients into two dichotomous cycles. In this respect, the circular economy is not just preventative of waste and extraction, but also restorative and regenerative in nature as both technical and biological materials remain within their cycles (Murray et al., 2017) (Figure 2.2). This is critically important for waste management, as combining the two cycles results in a breakdown of the resource potential, and can lead to 'metabolism' problems like plastic contamination in waterways and fires in dumpsites, triggered by the decomposition of organic nutrients.

To date, implementation of circularity at a global level is limited. Haas et al., (2016) calculated the global circulation of resources to be a minute 6%; this is primarily due to growth of in-use stocks (i.e., buildings) and the dominate use of fossil fuel energy carriers as the prominent energy source. The authors, however, indicated that considerable improvements of resource circularity are possible through better design that increases lifespans of products, provides service without materials, facilitates repair, resale, remanufacturing, and reuse, and as a final strategy, recycling (Bocken et al., 2016; Haas et al., 2016).

### 2.3.2 Scale and socio-cultural aspects of circularity – a key research gap

As a system-based concept, scale is an important consideration in the circular economy (Kirchherr et al., 2017). Consumers and responsible consumption need to be prioritized (Ghisellini et al., 2016; Lieder and Rashid, 2016), and this is evident in RLES strategies (Figure 2.3). At the micro scale, the actions, and behaviours of citizens - their consumption choices, their re-use strategies and their ability and willingness to participate in waste management - impacts waste generation and resource flows. Whether citizens are consulted and heard also impacts the legitimacy of governance structures, and conflict between elements of institutions, such as regulation and cultural practices.

Yet, Kirchherr (2017) finds that there is little discussion about consumers at the 'micro' scale in circular economy literature and definitions. For example, Geissdoerfer et al., (2017) suggests that the 'agency' (i.e., who makes decisions) about the circular economy is at the level of businesses, governments, and non-government organizations. An understanding of scale and interactions across scales is important for understanding the appropriate strategies and technologies. Murry et al., (2017) cites a number of examples of highly technical "green" products, that may be energetically expensive or impossible to breakdown, therefore limiting in circular nature. Therefore, *appropriate technologies*

(Schumacher, 1973), which are small scale, labour intensive, and locally adapted are likely to have less environmental impacts than larger scale, engineered solutions (e.g., Sianipar et al., 2013).

Several reviews of circular economy literature identified the absence or underrepresentation of social science research and investigation (Blomsma and Brennan, 2017; Murray et al., 2017; Sauvé et al., 2016). This is confirmed in Kirchher et al.'s (2017) review which found that 'social equity' was only included in 18-20% of circular economy definitions in the literature; evidently, there is a stronger focus on the environmental and/or economic pillars of sustainability. To date, it is not yet clear how the circular economy can lead to broader social sustainability goals of inter- and intra-generational equity and equality of opportunities along gender, racial and religious lines. Consequently, there is a risk that circularity of materials can come at a social cost. For example, further entrenching existing vulnerabilities associated with the informal labour of recycling workers. Furthermore, there is a need to investigate social phenomena like politics and labour within a circular economy framework (Geissdoerfer et al., 2017). Simultaneously, since wicked problems necessitate social, economic, and institutional changes, it is critical to recognize the social embeddedness of material interactions (Boons and Howard-Grenville, 2009) to understand the social, cultural, political, and behavioural parameters that impact waste at a local level (Bruel et al., 2018).

Consequently, the review of circular economy literature indicates a similar gap to sociometabolic studies and waste management research: the research tends to focus on biophysical or economic merits of the circular economy, to the ignorance of social issues, governance structures and actions at the micro (citizen) scale. The circular economy, however, does offer a different approach to thinking about waste management – beyond 'end-of-pipe' solutions to question and rethink consumption patterns.

## 2.4 Public participation in waste management

The importance of **public participation** in waste management decision making cannot be overstated, and represents a key, underdeveloped area in social metabolic and waste management implementation and research, particularly in Caribbean waste management research (Squires, 2006). The complexity, multi-scalar nature of wicked environmental problems demands decision making that is transparent, flexible to changing circumstances, and embraces a diverse set of knowledges, values, and perspectives (Reed, 2008).

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Public participation is critical for effective waste management for at least four reasons. First, waste management, as a sustainability challenge, demands new ways of knowledge production and decision-making (Garnett and Cooper, 2014; Lynch et al., 2018). Moreover, the importance of collaboration and transdisciplinary investigation between scientists, government, business, and citizens is growing with the entrenchment of wicked problems in sustainability and environmental management. Second, from a practical standpoint, citizens are waste generators, and therefore play a critical role in ensuring quality and durable solutions through their behaviors. Connecting back to the concepts of legitimacy and cultural-cognitive elements of institutions, citizens play an important role in developing a shared understanding of how to participate in waste management activities. Furthermore, citizens play a pivotal role in their purchasing decisions, waste processing and reuse, and how they dispose of their waste in their homes and communities. Consequently, it is important to investigate the intricacy, nuance, and agency of everyday actions with respect to citizen participation. This information can help to encourage habits and changes in individual and household decision making, as well as bring to light how governments can work with, instead of against, citizen preferences. Third, citizens have a democratic right to participate in environmental decision making, which includes waste management. The importance of an engaged public citizenship is affirmed in several multi-lateral environmental agreements and declarations, of which Grenada is a member. For example, Principle 10 of the Rio Declaration affirms the importance of participation by all citizens through access to information (United Nations General Assembly, 1992). Furthermore, the Principles 4 and 5 of the St. George's Declaration of Principles for Environmental Sustainability in the OECS indicates the importance of civil society and private sector participation in 'good' environmental management:

> *Civil society, the private sector, and local level governments and administrations participate meaningfully in decision making on the environment. Good environmental management depends on the regular involvement of the full range of stakeholders in the exchange of information, knowledge and lessons learned, and in the formulation of policies, strategies, plans and decisions. All stakeholders must also have access to clear and timely information on environmental matters in the opportunity to participate in an receive reports back on all decisions regarding development plans and actions that affect their use of and access to resources and their benefits, both now and in the future. Accessible avenues for stakeholder collaboration and for ongoing dialogue between states, organizations, communities, private sector entities and individuals must be integrated into*

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> *every level of national institutional frameworks for environmental management. (OECS, 2006, p. 9)*

The LBS Protocol of the Cartagena Convention in Article X indicates that parties shall "promote public access to relevant information and documentation concerning pollution… from land-based sources and activities and the opportunities for public participation and decision-making process concerning the implementation [of the protocol]" (United Nations, 1999). The importance of public participation, as well as access to environmental information, is further emphasized in the Escazú agreement, of which Grenada is a signatory but not a ratified party (ECLAC, 2018a).

Lastly, public participation promotes the integration of *local knowledge* in waste management planning, decision making, and strategy. Corburn (2003), in differentiating local knowledge with professional knowledge, discusses several definitions of local knowledge in the literature (see Box 2.2). For example, Geertz (1983, p. 75) defines local knowledge as knowledge that is "practical, collective and strongly rooted in a particular place" that forms an "organized body of thought based on immediacy of experience" (Corburn, 2003). Lindblom and Cohen (1979, p. 12) suggest that local knowledge is "knowledge that does not owe its origin, testing, degree of verification, truth, status, or currency to distinctive… professional techniques, but rather to common sense, casual empiricism, or thoughtful speculation and analysis".

Local knowledge can be a citizen's first-hand experience, or a collective accumulation within the community. It can improve environmental planning (and by extension, waste management planning) in at least four ways (Corburn, 2003): **epistemology,** that is the creation of new knowledge and countering reductionism typical of professional knowledge; **procedural democracy,** through the addition of excluded voices and fostering a weaving of voices; **efficiency and effectiveness** of policy decisions through identification of low-cost and innovative options; and, **distributive justice,** in which local knowledge facilitates acknowledgement of justice concerns facing marginalized communities.

1. **Who holds the knowledge?** Local knowledge is held by community members or a "knowledge community" with shared symbols, culture, language, norms, and interests, yet also intersectional and evolving in their individual identities. Professional knowledge is knowledge held by members of a profession, discipline, or institution.
2. **How was the evidence gathered?** Local knowledge is developed through experience, mediated through culture and traditions; evidence manifests as intuition, images, stories, and visual demonstrations. Tacit awareness and understanding are products of a historical experience.
3. **What makes the evidence credible?** Local knowledge is tested through observation over years of experiences. Two claims are often made: one observing a problem, and another hypothesizes a relationship between a problem and consequence.
4. **How is the knowledge and evidence tested?** Local knowledge is tested through public narratives, community stories, street theatre and public forums.

Box 2.2 Key questions differentiating local and professional knowledge (Corburn, 2003)

## 2.5 Chapter conclusion

By almost all accounts, insular social-ecological systems (SES) remain linear economies, with growing accumulation of waste that threatens ecosystems services, human wellbeing, and economic drivers (e.g., tourism). Island sociometabolism research has made seminal contributions, demonstrating the usefulness of island SES as units of analysis. This literature has quantified the material flows highlighting both sociometabolic risk, and to a lesser extent, sociometabolic sustainability. Island sociometabolic research, however, has focused on the 'natural sphere' of the social metabolism framework. While some research has acknowledged contextually dependent governance systems, like legislation, policies and cultural practice, the research is limited to 'expert' knowledge; this does not recognize or value citizen involvement in an island's social metabolism.

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Island waste management literature has focused on quantitative metrics; research is mostly future-casting, comparing 'end-of-pipe' options for islands to process and dispose of their waste in an efficient, optimized yet decontextualized manner. This has left an important gap in understanding citizen's behaviours and perspectives on waste, and the governance structures (i.e., legislation, policy, and economic instruments) that influence this behaviour. When research is 'future-casting', it fails to 'hold' governments and citizens to account for poor waste management practices, therefore limiting the ability and drive to transition to a more sustainable SES. While waste management decision making is beginning to focus on social factors (e.g., incorporating politics and social preferences) in addition to economic decisions (Su et al., 2007), the literature falls short in addressing the root causes or drivers of waste management in small island states. Notably, Lenzen (2008) suggests that growth, affluence, and consumption are not limitless on an island; there is both importance and benefits of islands living within their carry capacity. This remains an undertheorized area of island sociometabolic and waste management research.

Using a sociometabolic lens, the literature suggests many islands are at a tipping point in terms of sociometabolic risk with waste management and material use strategies. Dumpsites are full, with no space or appetite for landfill expansion, yet both consumption and waste generation continue to grow. With crisis and tipping points looming, islands have an incredible opportunity to re-imagine and re-think their material use strategies. The circular economy may be an opportunity for islands to think beyond end-of-pipe solutions for waste. As small islands have limited existing infrastructures (e.g., landfill, recycling facility), they are not 'locked in' to a particular waste management system. This means that there is an opportunity for innovation to adjust to new material use strategies, employing both 'island logic' and islander creativity.

Consequently, from this review emerges the broader research question of this dissertation: **What opportunities exist for islands to sustainably manage their waste?** This question can be answered using the social metabolism framework, by investigating the problem from both multiple perspectives: materiality, governance, and social/citizen's perspectives. As noted in this chapter, public participation is integrally important to sound waste management. The next chapter outlines the methods used to contribute to filling these gaps in social metabolism and island waste management research.

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# Chapter 3 Methods

A pragmatic philosophical worldview judges the value of knowledge based on its ability to serve a purpose for humanity (Moon and Blackman, 2014); in other words, it is largely focused on "what works" for the particular research problem (Patton, 1990 Creswell, 2014). Pragmatists contextually situate their research, and collect knowledge through a diversity of methods (Creswell, 2014). As a researcher, I find this philosophical framing to be useful for understanding complex, wicked problems like island waste management. With a pragmatic positioning, I am not interested in investigating a problem for its own sake, nor am I interested in excluding a knowledge source on the basis of disciplinary or interdisciplinary commitments. Consequently, this philosophical position led to me seeking knowledge from a variety of sources, contextually rooted in a particular place. Recalling that my dissertation uses social metabolism as a conceptual framework for understanding waste management sustainability, methods were selecting for assess sustainability from both a biophysical, material flows perspective and the social processes that support these material flows (Section 1.3.2).

My dissertation uses a transdisciplinary, case study approach to investigate Grenada's waste management system. Field work took place over the course of 8-months from September 2018 – April 2019. I lived with a Grenadian in the parish of Saint Georges, within walking distance of the main town of St. George's; this location enabled ease of access to the rest of the island via the main bus terminus in town. I selected my residence online prior to leaving Canada, in absence of relational knowledge of my Grenadian landlord. Serendipitously, this co-habitation and friendship proved to be a critical part of field work, allowing for introductions to Grenadians, discussion and reflection, and triangulation through a 'sounding board' on a daily basis. Common in field work, field notes, voice memos, videos with voice memos, and photographs (with geo-tags) were collected based on observations and conversations emerging from living in Grenada. Written records, voice memos and video voice memos were transcribed and coded inductively; these research artifacts were used to inform questions, areas of investigation, and validate claims made by participants in the study.

My study is geographically bound to the tri-island state of Grenada, including the islands of Carriacou and Petite Martinique. System boundaries are not objective or certain in scientific research because by drawing boundaries, researchers implicitly or explicitly eliminate actors, drivers, and pressures from consideration. Yet, the establishment of boundaries is not just practical, but necessary as researchers simply cannot and should not include all factors in (social-ecological)

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systems research (Meadows, 2008). Schooneveldt (2010) suggests that for systems research to be relevant for decisions makers, it must begin with a *relevant* focal point. Researchers should ask '*what affects this focal point that is relevant to decisions makers?'* and '*where do inputs originate, and where do they go?'* (Schooneveldt, 2010). For this dissertation, my focal point is waste materials deposited on or within land and in the immediate adjacent waters (e.g., litter on a beach). As a reminder, I define waste broadly as "any material or object the holder discards or intends to discard" (Haas et al., 2016, p. 261). My study boundaries are pragmatic, limited to materials that are either currently or would reasonably be expected to be managed by the Grenada Solid Waste Management Authority (GSWMA), as per the legislation (Government of Grenada, 1995a, sec. 11).

The GSWMA is a key partner in my research. Through a committee member, Dr. John Telesford, I was introduced to the GSWMA and established a working relationship. This relationship permitted access to data for material flow accounting (Section 3.2), introductions to experts (Section 3.3, 3.4), assistance with recruitment of participants (Section 3.5, 3.6), access to facilities for observations, and information about available grey literature (Section 3.7). Furthermore, Dr. John Telesford made initial contacts with several experts, as well as introductions to community groups that participated in citizen focus groups (Section 3.5). Establishing and accessing existing networks, building relationships, and information exchange in the form of data and insights were critical to my research. For example, active participation in the Grenada Green Group allowed me to share what I was learning, while also gaining insight into concerns about politics and human behavior. In this respect, my research takes a 'local' research approach, which as a researcher, I was both observing and embedding myself into society and engaging with local power and relational dynamics (Singh and Haas, 2016).

This chapter begins by describing Grenada's waste management system in a case description, followed by a review of the different methodological approaches used in the study.

## 3.1 Case description of Grenada's waste management system

Grenada is a tri-island, tropical Caribbean state with an estimated population of 112,003 in 2019, of which 64% are rural (The World Bank, 2019a). Carriacou and Petite Martinique represent approximately 5% of the population (Government of Grenada, 2011a). Most of the population as well as building stocks are in the southern areas of Grenada, as well as the major towns of St.

Georges and Grenville. The island of Grenada has a mountainous topography with 71% of lands being at least a 20-degree slope (Government of Grenada, n.d.).

As an island nation that is modernising and transitioning from an agrarian to service-based economy, Grenada is reliant on imported goods to meet the material and consumption needs of citizens and tourists. In 2017, travel and tourism accounted for 85% of the total exports (The Growth Lab at Harvard University, 2019) resulting in a significant demand for imports to support tourism demands and changing preferences of Grenadians (Figure 3.1A). From a material standpoint, Grenada imported 243,509 tonnes of goods, while only exporting 19,141 tonnes in 2017 (Grenada Central Statistics Office, 2017). While trade data formulates neat import/export categories, imported products are materially diverse (i.e., containing plastics, metals, and minerals in the same product) and complex to deconstruct, resulting in a lot of different materials that have to be managed by the GSWMA. The majority of imports into Grenada enter through the main port in the city of St. Georges, but there are some goods entering from other Caribbean islands through Carriacou and Petite Martinique.

| Sector | Export | Import | Balance |
|---|---|---|---|
| Agriculture | $26,951,283 | $72,683,310 | $(45,732,027) |
| Chemicals | $1,959,652 | $30,408,638 | $(28,448,986) |
| Electronics | $524,400 | $19,158,612 | $(18,634,212) |
| Machinery | $1,852,899 | $29,345,505 | $(27,492,606) |
| Metals | $485,907 | $13,349,088 | $(12,863,181) |
| Minerals | $55,506 | $5,707,670 | $(5,652,164) |
| Other | $2,192,467 | $23,264,794 | $(21,072,327) |
| Services | $549,250,078 | $230,782,148 | $318,467,930 |
| Stone | $335,854 | $7,222,734 | $(6,886,880) |
| Textiles | $266,186 | $13,729,463 | $(13,463,277) |
| Vehicles | $1,621,007 | $21,021,353 | $(19,400,346) |
| Total | $585,495,239 | $466,673,315 | $118,821,924 |

Table 3.1 Balance of trade in Grenada, 2017 (The Growth Lab at Harvard University, 2019)

Macroeconomic drivers, like tourism development and foreign direct investment, are likely contributing to a larger generation and diversity of materials ending up in the waste stream. Figure 3.1 presents select macroeconomic drivers that are increasing the demand for imports, construction of tourism and 'Citizen by Investment' properties, and ultimately increasing the waste generation on an already stretched system.

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Waste generated in Grenada is managed by the GSWMA, a statutory body established in 1995 (Government of Grenada, 1995a). Household waste is collected at least two days per week in rural areas, and up to seven days per week in urban centres. The GSWMA contracts private businesses to collect waste from households by collection zone. Two dumpsites, that accept both household collections delivered by contractor and private waste deliveries, are also managed by the GSWMA.

The Perseverance dumpsite is located on the western side of Grenada, a few hundred meters inland from Halifax Harbour on the Caribbean Sea. Perseverance is classified as an open dumpsite. The site has a gate to deter entry outside of business hours, however there is no fence surrounding the entire site. Materials dissipate into the environment due to lack of methane gas management, leachate management and daily site covering. Due to ongoing issues with fires and the accumulation of materials, Perseverance is an environmental and health hazard for Grenadians. As a mountainous nation, there is limited space for landfill and dumpsite operations, and Perseverance has been designated the only feasible location for waste dumping on the main island (Campbell, 2018; Rosenberg and Korsmo, 2001).

The Dumfries dumpsite is located on the island of Carriacou. Dumfries is also classified as an open dumpsite due to lack of fencing, lack of a gate to deter entry, and lack of management to prevent dissipation of materials into the environment. Waste from Petite Martinique is delivered by boat to Dumfries twice a week. Like Perseverance, Dumfries is also considered to be an environmental and health hazard for Carriacouans.

Research on Grenada's waste management system has been limited to institutional evaluations and research from development organizations. Rosenberg and Korsmo (2001) discussed lessons learned in the World Bank-funded OECS Waste Management Project. Their research highlighted the complexity of locating new disposal sites on island nations where species conservation (namely, the Grenadian Dove), waste management needs, and land availability come into conflict. More recently, the German development organization, GIZ conducted two research projects on waste in Grenada. In 2015, GIZ investigated methods to reduce marine litter from plastics (GIZ, 2015). Stakeholders cited several reasons for littering: ineffective legislation and regulatory frameworks, lack of rubbish bins, culturally engrained habits, lack of respect for the environment, and lack of street cleaning services in commercial areas. Researchers suggested several opportunities to reduce marine litter: a deposit system for beverage containers, a deposit system for other plastic waste, developing source

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separation of recyclables and building a mechanical biological treatment facility to deal with organic waste.

The GIZ has also analyzed the potential for waste-to-energy operations for solid and liquid waste (Rothenberger, 2015). The study found that incineration represented the best opportunity to reduce deposits to Perseverance, however it is only financially feasible with a minimum tipping fee of $100 EC/ton. Anaerobic digestion (AD), especially a decentralized approach, was suggested as a potential solution for energy production. AD provides less benefit to dumpsite capacity constraints compared to incineration but has a high energy potential and can accept a wide range of input materials (Rothenberger, 2015).

In 2013, the GSWMA began a 5-year Integrated Solid Waste Management (ISWM) project to update the national waste strategy, increase capacity and training, rehabilitate the collapsed landfill, and develop an additional semi-anaerobic cell at Perseverance. To date, consultants on the project have completed a waste characterisation study that will be used in this dissertation. The National Sustainable Development 2020-2035 plan also addresses the importance of improving waste management in Grenada. The plan suggests upscaling investments in waste-to-energy and recycling facilities as a solution to improving sustainability (National Plan Secretariat, 2019). It is presently unclear whether the ISWM strategy and national sustainable development plan will assist in implementing better resource and waste management in Grenada or reinforce patterns of accumulation of waste. This dissertation complements and support the implementation of both the ISWM Project and National Sustainable Development 2020-2035 plan.

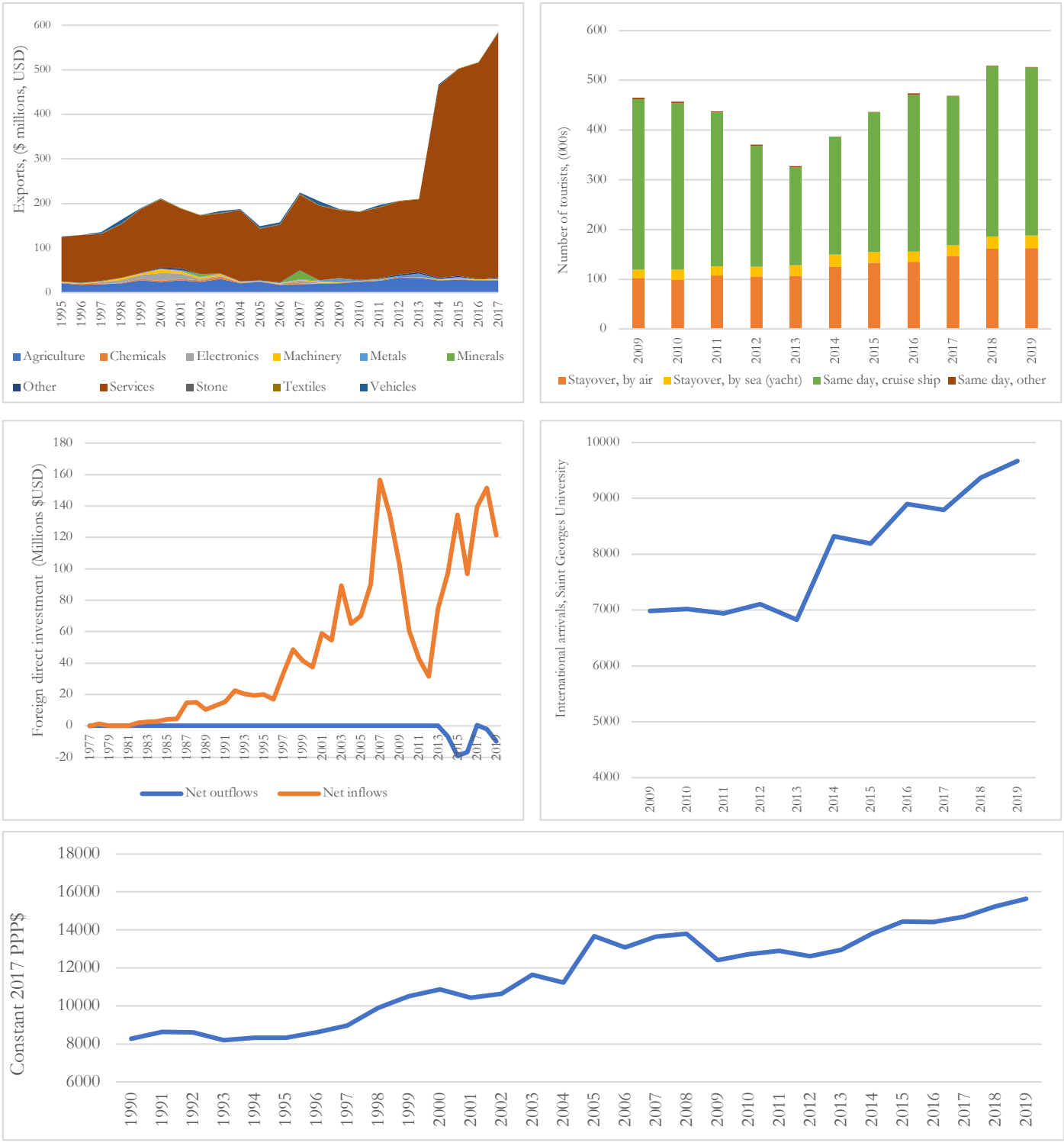


Figure 3.1 Selected macroeconomic drivers
a) Exports, Source: The Growth Lab, Harvard University b) Tourism arrivals, Source: GTA, 2020 c) Foreign direct investment Source: World Bank Development Indicators d) SGU international arrivals Source: GTA, 2020 e) Gross National Income (GNI) per capita (constant 2017 PPP$).

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## 3.2 Material flow accounting

Material flow accounting (MFA) provides a method to operationalize the interactions between the natural sphere and society's biophysical structures (hybrid sphere) of a social-ecological system using the social metabolism framework (Figure 1.1). MFA "provide(s) a biophysical representation of society-nature interactions" (Eisenmenger, 2016, p. 234) by measuring a how a society interacts with the environment (Eisenmenger, 2016, p. 234); in other words, MFA measures the types of materials that flow through a society and enable citizens to work, play and reproduce themselves and families over time. For planners and policy makers, MFA can provide the information required to make decisions about sustainable resource use, and therefore is an important first step in designing a more sustainable social-ecological system. MFA relies on the following equation:

$$\sum(I_T) = \sum(O_T) + \Delta(S_T)$$

with $\Sigma(I_T)$ equating to the sum of material/energy inflows into the system; $\Sigma(O_T)$ is the sum of outflows from the system; and $\Delta(S_T)$ is the change in material stock within the system. From this, there are two system boundaries where materials enter a social-economic system $\Sigma(I_T)$: *domestic extraction*, which are materials originating from the domestic environment, and *imported materials* from other socio-economic units (Eurostat, 2018) The outputs of the system $\Sigma(O_T)$ are also divided by internal and external: *domestic processed output* (DPO), which is waste and emissions that are deposited

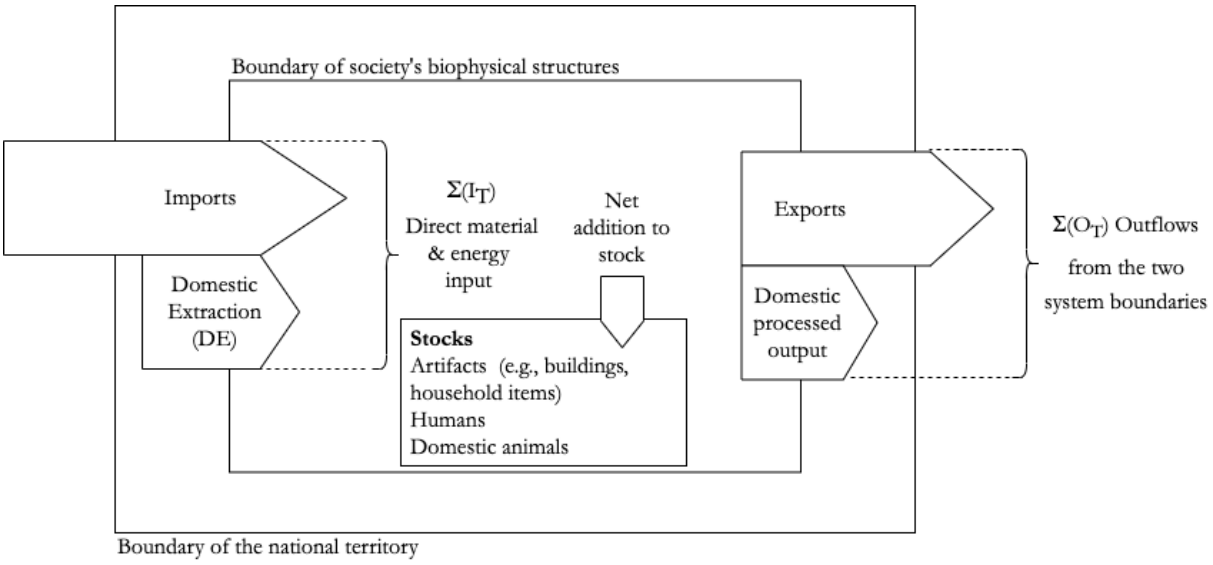


Figure 3.2 Generic Material Flow Accounting diagram

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within the domestic environment, and material exports to other socio-economies. MFA indicators are depicted in Figure 3.2 (Fischer-Kowalski et al., 2011).

The MFA framework conceptualizes 'solid waste' as either a net addition to stock $\Delta (S_T)$ when deposited into a controlled or sanitary landfill, or domestic processed output (DPO) when deposited in an open dumpsite or non-functioning landfill (Eurostat 2018; Krausmann et al. 2015).

As demonstrated in the Chapter 2, some island MFA studies have been completed at national level using statistical accounts (e.g., Eckelman and Chertow, 2009; Krausmann et al., 2014), there has been adaptations to the approach for local level studies which required varying levels of fieldwork to collect data (e.g., Singh et al., 2001; Singh and Grünbühel, 2003). Field work is particularly important for measuring outflows, especially in data poor environments like small island states; therefore, while inputs are usually captured in national statistics, outflows studies necessitate a case study approach.

For this dissertation, conceptualization of material flows, including waste generation, in island social-ecological systems is depicted in Figure 3.3. This figure makes the distinction between material flows that are measured and material and energy flows that are not measured in this dissertation. Materials enter in an island economy as inflows, ($I_T$), through importation of products as well as to a lesser extent, domestic extraction (DE) of materials on the island. Materials may either be immediately consumed or further processed prior to consumption. If materials remain in the economy for more than one year, they are a net addition to stock, $\Delta (S_T)$. Waste generation occurs as materials shift from consumption of short-lived products, as well as the degradation of stocks overtime. Waste resources accumulate in the environment, either the dumpsites on the island or illegal dumping areas as DPO.

Material accounts of Grenada's waste management system was conducted using secondary-sourced quantitative data, supplemented by expert interviews (Section 3.3) and observations during field work. Table 3.2 provides a summary of data sources and calculations by material flow, depicted by Figure 3.3, that are further elaborated on in the subsequent sections of this chapter. A working partnership with the GSWMA was critical to getting access to non-confidential, non-publicized waste statistics and characterization data. The MFA looks at the year 2017, a baseline year prior to implementation of the Non-Biodegradable Waste Control Act (Government of Grenada, 2018a).

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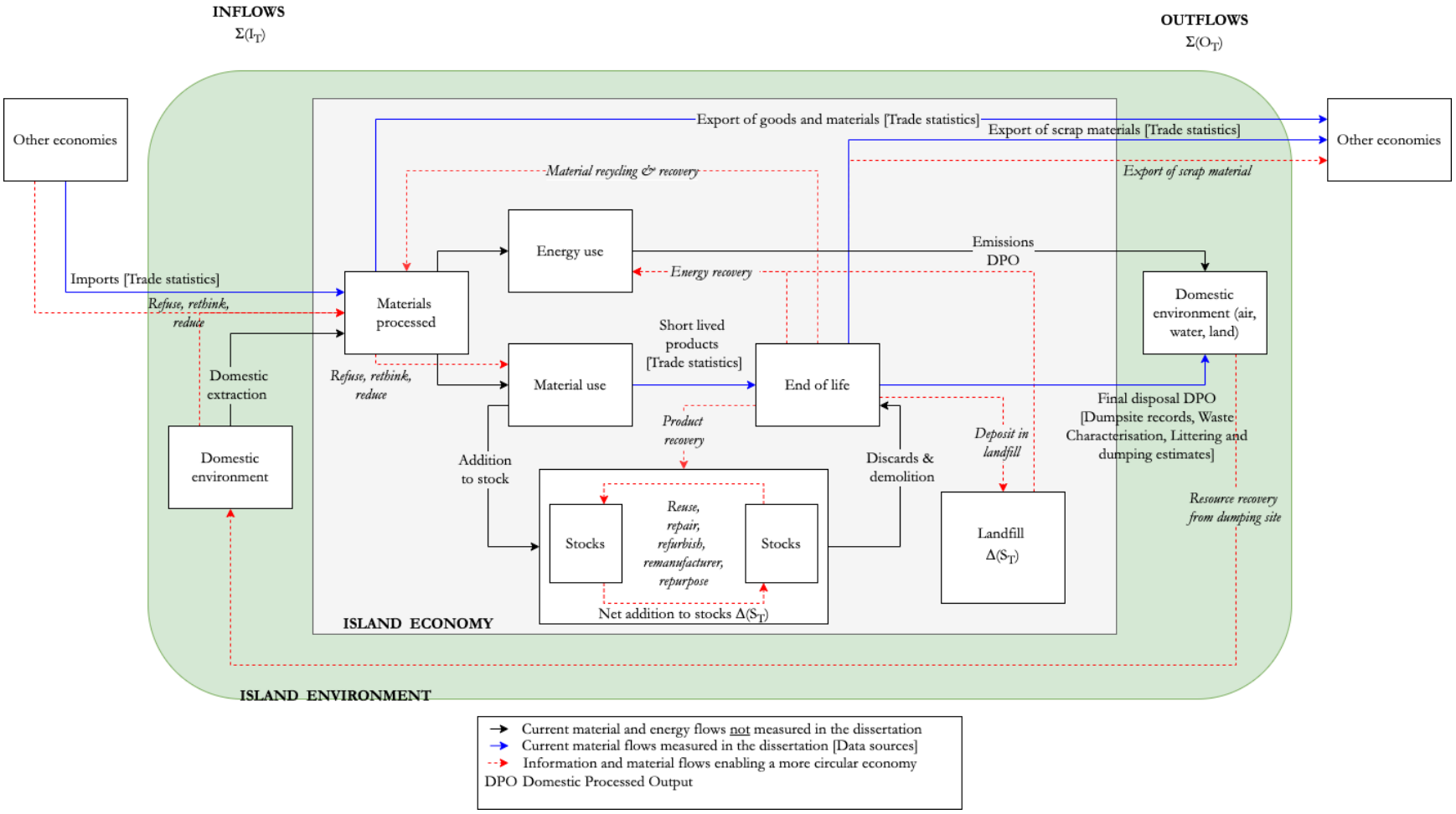


Figure 3.3 MFA Conceptual framework, adapted from Elgie et al., 2021

| Flows | Sub-flows | Data Sources | Processing, calculations, and assumptions |
|---|---|---|---|
| Final disposal DPO | Total waste managed by GSWMA | Dumpsite weight and entry records for 2017 | Estimates using vehicle registration, sector, and vehicle type |
| | | Waste characterization data | Total non-segregated waste is multiplied by material categories of waste characterization studies (Est_1, Est_2 & Est_3) |
| | Littering and dumping | Jambeck et al., 2015, 2011 Census | 2% of total final disposal minus organic waste |
| Imports<br><br>Short-lived products | Plastics | Plastic Packaging - Mass-Balance | Final disposal of plastics for Est_1, Est_2, and Est_3, subtracting estimates of plastic from HS 20, 22 & 39. |
| | | Trade data – HS 39 | Classified by three use phase: finished goods, intermediate goods and raw goods, and durability (stocks or outflows). |
| | | Trade data HS 20 & 22 | Used estimated weights of bottles multiplied by quantities reported in trade statistics. |
| | | Physical preform sample | Collected through field work. |
| | Tyres | New and used tyres - HS 4011, 4012 | Assumed all tyres imported lead to waste, tyre stock increases by vehicle imports. |
| | Motor Oil | HS 2710.19.70,<br>HS 2710.19.71,<br>HS 2710.19.72,<br>HS 2710.19.73 | |
| | | Kuczenski, Geyer, Zink, & Henderson, 2014 | 18% of oil dissipates; oil imports used within one year but remain as 'stock' in unknown quantities. |
| Exports of goods and materials | Plastics | Trade data | Subtracted from import estimates for net import of plastic. |

Table 3.2 Summary of data sources and calculations by material flow

### 3.2.1 Final Disposal DPO

The Final Disposal DPO flow is calculated by estimating the amount of waste that enters into Perseverance and Dumfries. These estimates are then divided into waste that is segregated by material category and waste that is non-segregated or co-mingled. For all of the waste estimates that are co-mingled, waste characterisation audits are applied to determine the material contents. Material category estimates from both segregated and non-segregated loads are then added to determine the total DPO to dumpsites, or waste that is directly managed by the GSWMA. Finally, littering and dumping estimates are added to determine the Final Disposal DPO flow. The process for calculating the Final Disposal DPO is outlined in Figure 3.4, and elaborated on in the subsequent sub-sections.

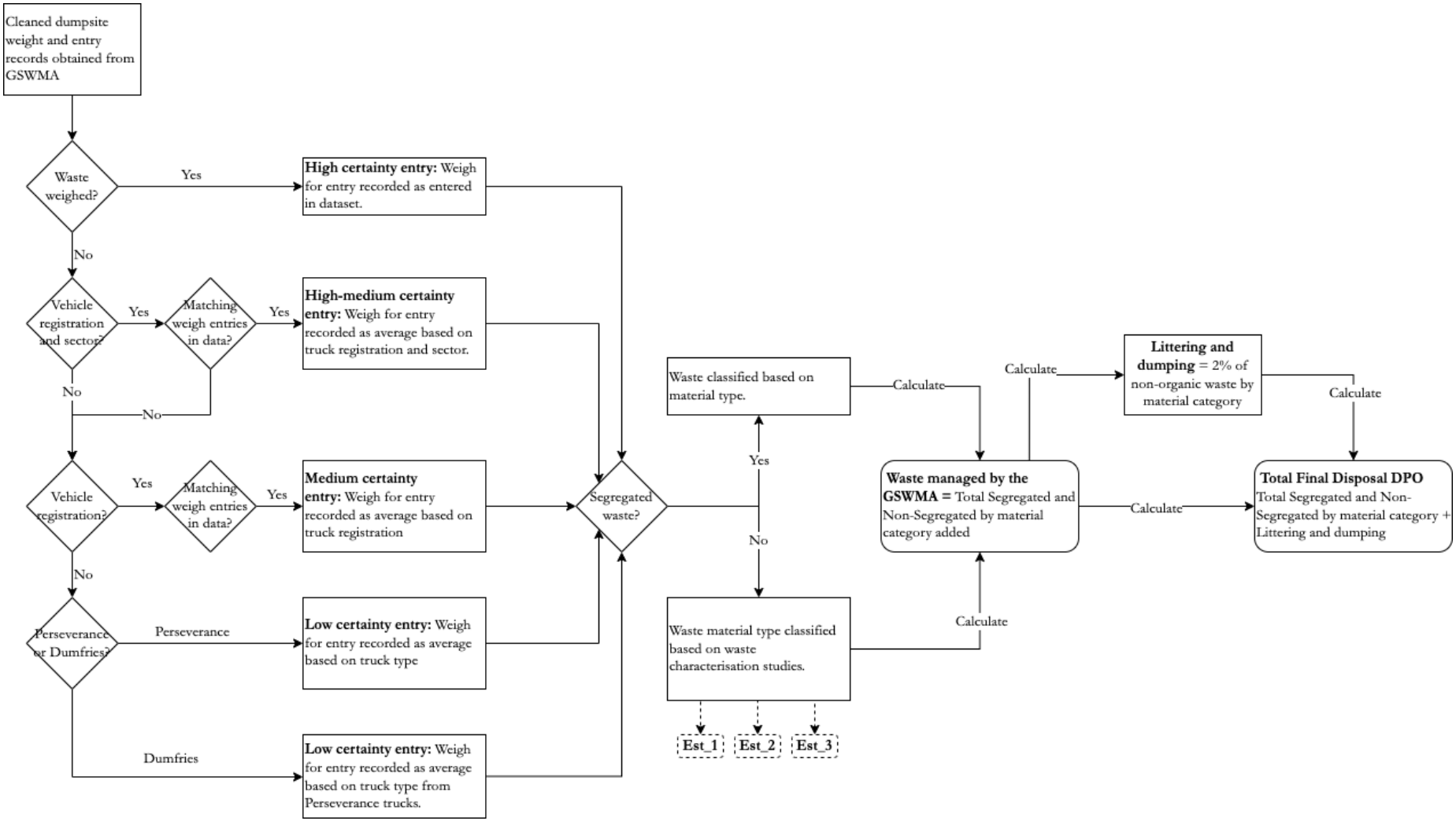


Figure 3.4 Process flow for calculating Final Disposal (DPO).
Dotted lines to Est_1, Est_2 and Est_3 indicate sub-processes that are further illustrated in Section 3.2.1.2.

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#### 3.2.1.1 Dumpsite weight and entry records

Waste weight and entry records were obtained from the GSWMA for 2017. For the Perseverance dumpsite, entry records include truck registration numbers, sector classifications (e.g., household, commercial), and material categories (e.g., tyres, co-mingled). The weight of the waste is recorded six days per week; waste is not weighed on Sundays and Public Holidays. Waste data at Perseverance is recorded manually by weighbridge attendants and therefore required extensive cleaning prior to analysis. The Perseverance database contained 19,094 row entries in 2017, corresponding to at least the equivalent trucks entering the dumpsite. The following cleaning procedures were used to clean the data:

- Fixing data entry errors including wrong dates and incorrect/inconsistent spelling of material types and sources.
- Fixing weight entry errors that did not include an entry or exit weight for the vehicle, resulting in an inaccurate weight. If weights were negative or grossly overweight, estimates were used.
- Material categories 'Green' and 'Construction' used by the GSWMA were changed to be classified by sector (household, industrial, institutional, government services or ship), with segregated loads of either organics or construction materials.

For Dumfries, waste is not weighed due to lack of weighbridge and control of entry. However, a GSWMA employee counts the number of trucks entering during business hours. Estimates were classified for accuracy from high to low certainty, as summarized in Table 3.3. If waste was not segregated, that is identified as being one material type in the dataset, it was further processed using procedures outlined in Section 3.2.1.2.

| Dumpsite | Methodology | Certainty |
|---|---|---|
| Perseverance | Weigh records | High |
| | Estimates using vehicle registrations and sector of waste | High-medium |
| | Estimates using vehicle registration | Medium |
| | Estimates using average weight of waste based on the vehicle type | Low |
| Dumfries | Estimates using average weight of waste based on the vehicle type at Perseverance. | Low |

Table 3.3 Data quality assessment of waste weight estimates at dumpsites

The GSWMA also collects weight statistics of ferrous metals that are baled and removed from the dumpsite by recyclers. Using bale statistics, the weight of ferrous metals leaving Perseverance was estimated based on recorded and previous weights linked by truck registrations. Ferrous metal bale

records required estimates to fill in data missing from the 'tare' weights of the trucks as well as no records of weight. The methodology and level of accuracy is summarized in Table 3.4. Out of 93 entries recorded in 2017, 70 entries were recorded with incomplete information. This severly limited the accuracy of the data.

| **Level of estimate certainty** | **Methodology** | **Number of data entries** |
|---|---|---|
| High | Weight records | 23 |
| Medium | Weight records of total truck weight recorded but estimated truck tare weight using vehicle registrations and previous tare weights in bale dataset. | 30 |
| Medium-Low | Weight records of total truck weight recorded but estimated truck tare weight using vehicle registrations and previous tare weights in Perseverance dataset. | 11 |
| Low | No total truck weight is recorded. Used the quantities of bales and the average bale weight calculated using the 'High Certainty' records. | 29 |

Table 3.4 Estimates of ferrous metal bales

#### 3.2.1.2 Waste characterization studies

Through consultants, the GSWMA has completed three waste audits (2003, 2009 and 2018). The original 2009 study results were not available and are excluded from the dissertation[6]. Using waste audit data, the material contents of the co-mingled/non-segregated waste deliveries to Perseverance and Dumfries dumpsites were estimated. Waste loads that were recorded by material type (e.g., organics, construction materials) were classified as segregated loads and assumed to only include one material type. Table 3.5 presents details about the estimates generated from the three characterization studies.

[6] The results of the waste characterization study are available from GIZ (2015) and Rothenberger (2015).

| Estimate | Study | Timing | Locations |
|---|---|---|---|
| Est_1 | Conducted by consultants from WSP as part of National Waste Management Strategy update in ISWM project (WSP Caribbean Limited, 2018a) | February – March, 2018 | Perseverance & Dumfries |
| Est_2 | | | |
| Est_3 | Conducted by Dillon Consulting Limited and published in National Waste Management Strategy (Government of Grenada, 2003) | December 2002 | Perseverance |

Table 3.5 Description of waste characterization studies

The waste characterization study conducted by consultants and reported in the baseline study for the ISWM project (WSP Caribbean Limited, 2018a) was used to calculate the material contents for Est_1 and Est_2. As this data is not publicly available, it is reported in Table 3.6 and Table 3.7 for transparency. These estimates differ based on the level of disaggregation. Est_1 waste was dissaggragated by dumpsite (i.e., Perseverance or Dumfries) but not by sector (e.g., household, ICI).

| Material | Perseverance | Dumfries |
|---|---|---|
| Organic | 28.7% | 11.1% |
| Other waste - hazardous | 2.9% | 0.8% |
| Paper, cardboard and polycoat | 13.9% | 14.1% |
| Special care waste (pampers, tissues etc.) | 6.4% | 3.0% |
| Glass (non-refundable) | 6.6% | 12.4% |
| Glass (refundable) | 1.3% | 4.4% |
| Construction, Demolition & Site Cleaning | 2.7% | 8.3% |
| Metals (Non-ferrous) | 1.7% | 3.6% |
| Metals (Ferrous) | 4.8% | 10.6% |
| Hard plastics | 10.1% | 10.4% |
| Soft plastics | 3.6% | 4.3% |
| Textiles | 5.9% | 7.5% |
| E-waste | 3.2% | 5.9% |
| White goods and electronics | 0.2% | 0.2% |
| Other waste - non-recyclable, non-hazardous | 8.1% | 3.5% |
| Total | 100% | 100% |

Table 3.6 Waste characterization results by dumpsite for Est_1 (WSP Caribbean Limited, 2018a).

The process for applying the waste characterizations from Est_1 to non-segregated waste entries is depicted in Figure 3.5.

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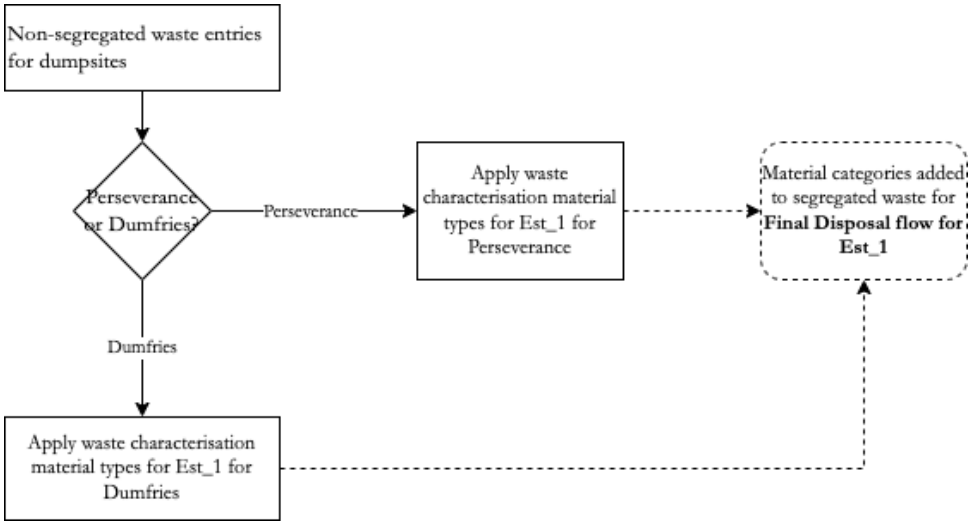


Figure 3.5 Process for estimating waste composition of non-segregated waste deliveries for Est_1

For Est_2, waste characterisation data was dissaggragated by sector (Household, ICI, Tourism and Other) for the Perseverance dumpsite (Table 3.7).

| Material | Residential | ICI | Tourism | Other |
|---|---|---|---|---|
| Organics | 25% | 22% | 36% | 18% |
| PGM | 33% | 32% | 32% | 24% |
| Paper, cardboard | 9% | 15% | 17% | 18% |
| Waste | 17% | 9% | 11% | 15% |
| CRD | 3% | 10% | 4% | 5% |
| Other waste (including special care, hazardous and non-hazardous /nonrecyclable) | 12% | 12% | 1% | 10% |
| White Goods | 0% | 0% | 0% | 0% |
| Total | 100% | 100% | 100% | 92% |

Table 3.7 Waste characterization results by sector (Est_2) (WSP Caribbean Limited, 2018a)

To use the estimates reported in Table 3.7 in the MFA, however, some adjustments were required due to lack of transparent reporting in the consultancy report. As a number of the material categories were aggregated together (i.e., plastics, glass and metals were aggregated into PGM), written commentary from WSP Caribbean Limited (2018a) was used to disaggregate the material

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categories. The disaggregations, which are the quantities used for Est_2 in the results, are presented in Table 3.8.

| Material | Household | ICI | Tourism |
|---|---|---|---|
| Organic | 25.0% | 22.0% | 36.0% |
| Other waste (including special care, hazardous and non-hazardous/nonrecyclable) | 17.0% | 9.0% | 9.0% |
| Paper, cardboard and polycoat | 9.0% | 15.0% | 17.0% |
| Glass (non-refundable) | 6.0% | 6.0% | 17.0% |
| Glass (refundable) | 2.0% | 0.0% | 0.0% |
| Construction, Demolition & Site Cleaning | 3.0% | 10.0% | 4.0% |
| Metals | 10.0% | 1.0% | 12.0% |
| Hard Plastic | 11.0% | 22.0% | 2.0% |
| Soft Plastic | 4.0% | 3.0% | 2.0% |
| Textiles | 10.0% | 1.0% | 0.5% |
| E-Waste | 3.0% | 11.0% | 0.5% |
| | 100.0% | 100.0% | 100.0% |

Table 3.8 Est_2 waste characterization used in Chapter 4 Results

For Est_2, the Tourism category characterisations were used for waste that was delivered by a tourism organization, such as a hotel, as well as ship delivered waste. ICI was used for Institutional, Government Services, and Commercial waste. For Dumfries, characterisation by sector were not reported (WSP Caribbean Limited, 2018a); therefore, characterisation from Est_1 were used (Table 3.6). The 'Other' sector (Table 3.7) was not used in the MFA results due to lack of clarity around what 'Other' referred to in the report (WSP Caribbean Limited, 2018a). The process for estimating the waste composition of non-segragated waste for Est_2 is depicted in Figure 3.6.

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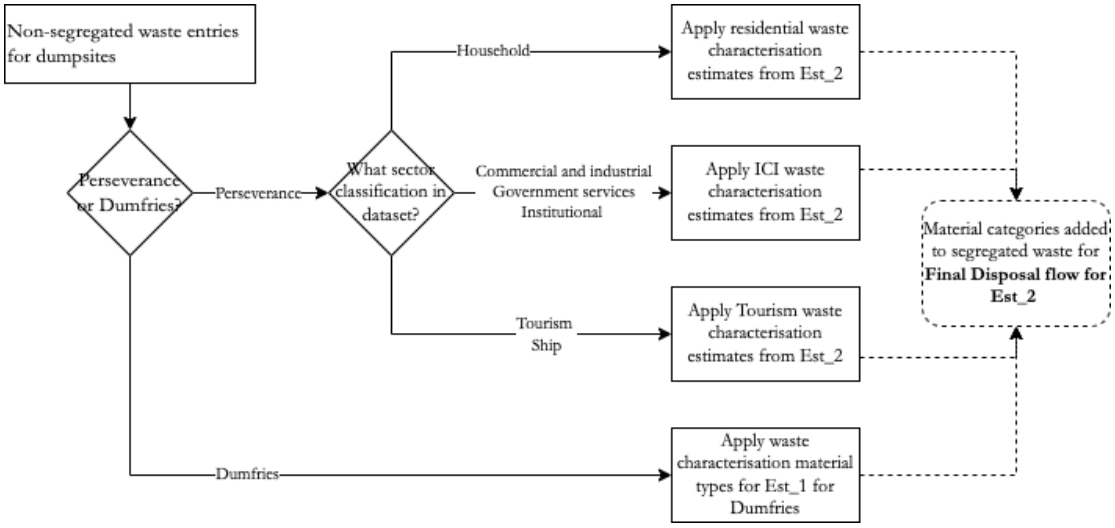


Figure 3.6 Process for estimating waste composition of non-segregated waste deliveries for Est_2

Est_3 comes from a waste characterisation study conducted by Dillion Consulting Limited for the National Waste Mangement Strategy, which is publicily available via the GSWMA's website (Government of Grenada, 2003) and summarized in Table 3.9.

| **Material** | **Residential (Rural)** | **Residential (Urban)** | **ICI (Non-Hospitality/ Tourism)** | **ICI (Hospitality/ Tourism)** |
|---|---|---|---|---|
| Paper and paperboard | 17.9% | 19.5% | 34.9% | 24.2% |
| Glass | 7.3% | 8.8% | 11.8% | 2.8% |
| Metal | 10.1% | 7.8% | 4.3% | 5.3% |
| Plastic | 11.6% | 13.7% | 14.0% | 15.1% |
| Textiles | 5.1% | 5.1% | 4.0% | 2.3% |
| Organics | 46.4% | 43.7% | 26.9% | 49.8% |
| Construction and demolition | 1.5% | 1.3% | 2.1% | 0.1% |
| Special Care Waste | 0.1% | 0.0% | 2.1% | 0.0% |
| Other Waste | 0.0% | 0.0% | 0.0% | 0.3% |

Table 3.9 Est_3 waste characterization from National Waste Management Strategy (Government of Grenada, 2003)

For this dissertation, the ICI (Hospitality/Tourism) characterisation was applied to both ship and tourism waste. For Dumfries waste, it was assumed that 'Residential Rural' sector outlined in the results of the characterisation. The process for estimating the waste composition of non-segragated waste for Est_3 is depicted in Figure 3.7.

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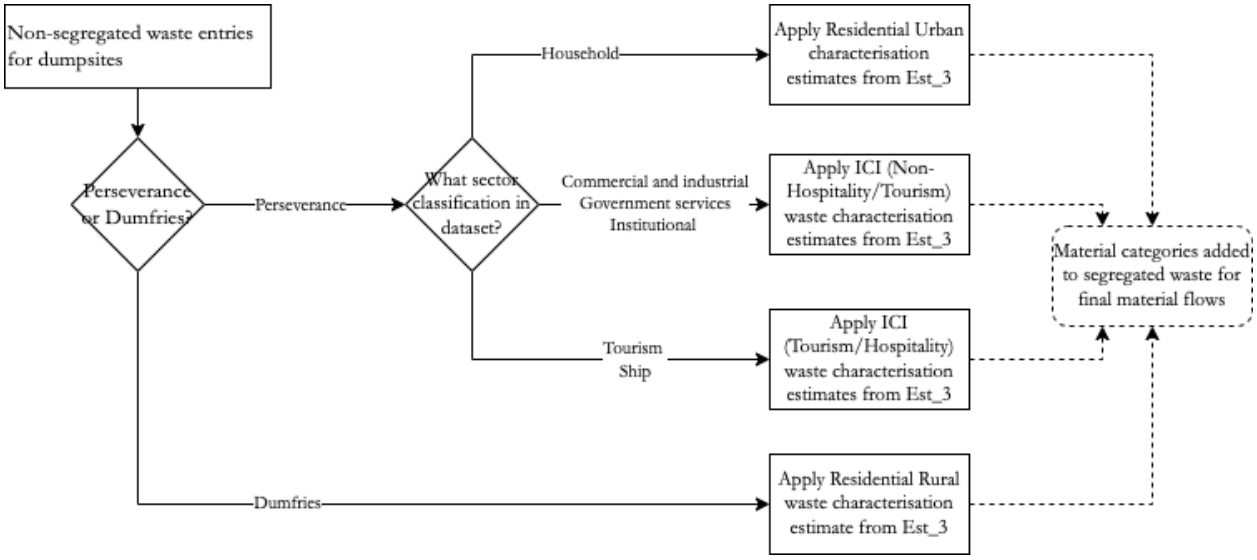


Figure 3.7 Process for estimating waste composition of non-segregated waste deliveries for Est_3

#### 3.2.1.3 Littering and dumping estimates

The amount of waste littered or dumped in the environment was estimated to be 2% of total waste deliveries to the dumpsites (Final Disposal flow). This is justified through two sources of evidence. First, the Grenadian Population and Housing Census of 2011 indicated that 1.5% of households dispose of waste in manners other than collection and composting (Government of Grenada, 2011a; Kaza et al., 2018)[7]. Second, Jambeck et al. (2015a) estimated that 2% of the total waste generated is littered and used 2% to calculate the marine litter potential for Grenada (Jambeck et al., 2015b). This dissertation used 2%, justified based on observations of the severity of dumping and littering in Grenada. Organics were excluded from littering quantities as biological materials return to nutrient cycles and are assumed unrecoverable in the island social-economic system. Additionally, the GSWMA currently does not accept motor oil, and therefore only trade statistics and observations were used to quantify motor oil waste. To calculate littering and dumping, the total Final Disposal quantities by material category were multiplied by both 1.5% and 2%, excluding organic waste. Littering and dumping estimates are added to Final Disposal to determine the amount of waste that enters the environment as DPO.

[7] Personal communication with the Ministry of Finance confirmed that the census question asked to households was "What is your main method of garbage disposal?".

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### 3.2.2 Single-Use / Short Use Products

In addition to a full material outflows account, the results of the MFA also focus on three problematic materials: plastics, tyres, and motor oil. These materials were selected as they are particularly challenging for small island waste management systems (UNEP, 2019a). Additionally, from a methodology standpoint, these materials are easy to isolate in trade data.

Trade data was obtained from the Central Statistics Office. In Grenada, trade statistics are reported using the Harmonize Commodity Description and Coding System (HS) at commodity-level (8-digit code) (Caribbean Community Secretariat, 2018). Trade data was obtained for plastics (HS 39), and water and juice imports (HS 20 and HS 22), new and used tyres (HS 4011 and 4012), and motor oil (HS 2710.19.70, 2710.19.71, 2710.19.72, and 2710.19.73). For each of the product commodity codes, the mass in kilograms and the value in EC$ are reported. For commodities charged a levy under the Environmental Levy Act of 1997 (Government of Grenada, 2015a, 1997), the quantity of products and levy paid were also included in the dataset. For clarity, the eight-digit commodity codes were matched to chapter and heading descriptions in the Revised Common External Tariff of the Caribbean Community guide (Caribbean Community Secretariat 2018).

To process plastics from HS 39 import data, the product categories were classified into three use phases (Millette et al., 2019). *Finished goods* are products that arrive in Grenada in a finished form and used without further processing. *Intermediate goods* are partial products that require further processing or manufacturing before they are ready for consumption. *Raw goods* are products that arrive in Grenada as a primary input for processing or manufacturing. All finished, intermediate and raw materials can become waste products within one year depending on use phase. Products were further classified as either durable stocks or non-durable outflows. For raw plastic resins, an attempt was made to determine the product fates of the raw resins to evaluate the durability of the product (Millette et al., 2019). When the product fate of the resin was unable to be determined, it was assumed to be a durable product. Classification of products imported in HS 39 is available in Dataset_1 of the 'Supplementary material for Chapter 3: Methods', of the public files that supplement this dissertation.

To process plastics from HS 20 and HS 22, it was assumed that all waters (HS 22) are imported in plastic beverage containers, except for aerated water (HS 2201.10.20) while alcoholic beverages are imported in glass. For juice (HS 20), 70% of juice imports were assumed to be imported in plastic

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bottles. For both water and juice bottles, an assumed bottle range of 12 g and 20 g of PET plastic was used.

Packaging and embedded plastics for all other commodities containing plastics were estimated through mass-balance with the total estimated plastics deposited in the dumpsites from Est_1, Est_2, and Est_3, in line with work from Millette et al. (2019).

### 3.2.3 Assumptions in the MFA results

These following assumptions were made about the MFA data sources and flows in the conceptual framework (Figure 3.3) as per Elgie et al., (2021):

a. *Trade statistics are accurate:* Customs and Excise division reports trade statistics, and the Central Statistics Office records trade statistics with reasonable accuracy. The CSO was given the opportunity to verify the data retrieved from their dataset.
*b.* *Waste characterisation studies are accurate:* Waste characterisation data reflects the true waste composition for co-mingle deposits in the dumpsites.
c. *Flows are in equilibrium:* Imports of consumable products lead to waste within one year. This study does not model net additions to stock or the useful life of products.

## 3.3 Expert interviews

I conducted 27 semi-structured expert interviews with 30 government officials, waste management professionals, environmental consultants and lawyers, and business owners/managers[8] (Table 3.10). I defined 'expert' broadly as an individual identified to have more than average knowledge about the waste management system, or influential areas of waste management, compared to an average person. Participants were identified through purposive sampling strategy (e.g., targeted online searches, visits to waste management operations), followed by snowball sampling of individuals identified by interviewees.

A 'semi-structured' interview follows an open format without a strict question-answer design. For both expert and citizen interviews, participants were free to talk about and expand upon topics as they emerged as part of a conversation; I followed an interview protocol with prompting questions to facilitate a fluid discussion. The interview protocol was designed to last 1-hour, but the length of the interviews ranged from a half hour to 2 hours depending on engagement and level of knowledge

[8] One interview had two participants, and another interview had three participants.

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of the expert. Through the informed consent process, interviewees had the option to be audio recorded. Audio recorded interviews were transcribed verbatim. If the interviewee did not consent to be audio recorded detailed notes were captured by the researcher. Of the 30 participants, 20 agreed to be audio recorded, while 10 opted for notetaking only. Both interview transcriptions and notes were coded using an exploratory, inductive approach, capturing a wide breath of themes and verbatim excerpts deemed relevant and meaningful to waste management challenges in Grenada. Following the first round of coding, excerpts were grouped thematically around emerging themes. Following the coding process, interviewees were provided the opportunity to comment, provide feedback and amendments, as well as approve quotes used in this dissertation. Of the 27 sets of transcriptions and notes from 27 interviews, 5 provided feedback leading to amendments and additions to the dissertation, and 6 participants confirmed accuracy without amendments. The recruitment, consent and interview materials are available in Appendix 5-7.

## 3.4 Expert focus group

A focus group is group interview in which multiple participants are invited to answer questions and discuss a particular topic. I conducted one expert focus group with GSWMA employees on April 16, 2019. This focus group was attended by five GSWMA employees at the GSWMA head office and was not open to non-GSWMA employees. The findings from this focus group are attributed as Focus Group 1 in this dissertation. The employees were recruited via personal communication and provided with an Information Letter (Appendix 8), which informed participants of the Informed Consent process.

In the focus group, I first presented preliminary results of the research, particularly from the MFA portion of the study, as part of an information exchange and to establish baseline knowledge on my study. The presented results were similar to the results presented at the St. George's University Research Day, as well as a GSWMA Board meeting in 2019. A copy of the presentation slides is available in the public files of this dissertation 'Supplementary materials for Chapter 3: Methods'; this presentation alludes to the *preliminary* results at the time (April 16, 2019), and were subject to further methodological refinement and data cleaning procedures to produce the final findings presented in Chapter 4.

The goal of the focus group was to get their expert feedback on preliminary results of the study. The following general questions framed the session: *What is missing? What is misinformed? What is*

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*mischaracterized? What have I failed to notice? What do you think is important?* Aligning with the expert interviews, this focus group transcription was coded using an exploratory, inductive approach, capturing a wide breath of themes and verbatim excerpts deemed relevant and meaningful to waste management challenges in Grenada. After generating a first round of codes, excerpts were grouped thematically around emerging themes.

| **Participant(s) identifier** | **Audio recording (Y/N)** | **Attribution or affiliations** |
|---|---|---|
| 1 | Y | GSWMA Management |
| 2 | Y | PFW Director, Founder & Designer |
| 3 | Y | GSWMA Management |
| 4 | Y | GSWMA Management |
| 5 | N | Confidential interviewee |
| 6 | Y | GSWMA Employee |
| 7 | Y | GSWMA Employee |
| 8 | N | GSWMA Employee |
| 9 | Y | Technical Advisor |
| 10 | Y | Hotel employee<br>Hotel owner |
| 11 | Y | Agronomist – Ministry of Agriculture |
| 12 | N | Spice Isle Recycling |
| 13 | N | Ministry of Health employee<br>Ministry of Health employee<br>Ministry of Health employee |
| 14 | N | GSWMA Employee |
| 15 | Y | Hotel owner |
| 16 | N | Ministry of Finance |
| 17 | N | Chief Environmental Health Officer |
| 18 | Y | GSWMA Board Member |
| 19 | Y | Pharmacist/Chairman of Pharmacy Council |
| 20 | Y | Confidential interviewee |
| 21 | Y | Confidential interviewee |
| 22 | Y | Government official |
| 23 | N | Bureau of Standards |
| 24 | Y | Confidential interviewee |
| 25 | Y | Confidential interviewee |
| 26 | Y | Ministry of Health employee |
| 27 | Y | General contractor |

Table 3.10 Expert participants attributions and/or affiliations

## 3.5 Citizens focus groups

A list of focus groups is included in Table 3.11. Focus group participants were initially recruited through public invitations (Focus Group A and C) posted on numerous community websites, the GSWMA Facebook page (Appendix 9) as well as posters, as per the Citizen Interviews recruitment process (Appendix 10). Due to initial challenges with recruitment of individual focus group participants, I reached out to several community organizers and organizations to see if they were interested in supporting the research. Five out of the seven focus groups conducted for this research were conducted with members of a community organization recruited from the organization's leadership team and were not open to the public.

| **Focus Group No.** | **Location** | **Method of recruitment** | **Number of attendees** |
|---|---|---|---|
| A | St. George's, Saint George | Public invitation | 4 |
| B | Grenville, Saint Andrew | Private invitation | 5 |
| C | St. George's, Saint George | Public invitation | 2 |
| D | Clozier, Saint John | Private invitation | 5 |
| E | Gouyave, Saint John | Private invitation | 15 |
| F | Bathway Beach, Saint Patrick | Private invitation | 5 |
| G | St. George's, Saint George | Private invitation | 13 |
| **Total:** | | | **49** |

Table 3.11 Focus group information

Focus group participants were provided with an Information Letter (Appendix 11) which includes a statement of implied consent and indicated that the session would be audio recorded. While initially, the researcher intended to conduct a Rich Picture (Section 3.6) in a focus group setting, due to attendance limitations and setting limitations (e.g., lack of tables), and reactionary feedback from organizers, the researcher chose to focus on verbal discussion only in 6/7 of the focus groups. The interview protocol for the focus groups followed the same script as the semi-structured interviews with citizens (Appendix 15).

## 3.6 Citizen rich pictures and semi-structured interviews

Aligning with the pragmatic and transdisciplinary focus of this study, visual methods were used to capture an understanding of Grenada waste management system. Visual methods use images and other artefacts created by participants to enhance the research or intervention (Prosser, 1996). Visual artefacts can be a powerful tool that allows researchers to transcend traditional disciplinary

boundaries and access knowledge that is not possible with interviewees alone (Packard, 2008; Wyborn and Cleland, 2010). While visual methods have a long-term tradition in sociology and anthropology, there are only a handful of examples of applying visual research techniques to social-ecological systems (Wyborn and Cleland, 2010). Therefore, this aspect of the research will contribute to expanding research methods in the field of social ecology, as well as providing several benefits as a research technique.

A 'rich picture' is the "expression of a problem situation complied by an investigator, often by examining elements of structure, elements of process, and the situation climate" (Checkland, 1981, p. 164). Rich pictures have been shown to enhance the interviews in a at least three ways (Wyborn and Cleland, 2010): (1) by focusing participant on the key topic of the interview; (2) by establishing rapport between interviewer and the participants; and (3) by creating a visible record helps to connect interviewees to knowledge to their own actions. This knowledge-action connection is particularly important in wicked problems as citizens realize that they are embedded within (not external to) the waste management system.

This study used rich pictures as a "jumping off point" preceding the semi-structured interviews with citizens. I conducted 18 individual interviews with citizens[9] (Table 3.12). Citizen participants were recruited through online posts on public forums (i.e., Facebook, GSWMA website), posting posters in the 6 main towns (Appendix 10), and word-of-mouth communication during field work. Each participant received an Information Letter (Appendix 12) either electronically or as a hard copy. Through the Informed Consent process (Appendix 13), interviewees had the option to draw rich pictures prior to discussing the interview questions. 10 of 18 interviewees elected to draw pictures at the beginning of the interview. Interviewees also had the option to allow the interview to be audio recorded. 17 interviewees elected to have their interview recorded, while one interviewee chose for me to record detailed notes of our conversation. Participants were asked to draw a rich-picture series based on the following questions, given sequentially:

1. What is the ideal Grenadian waste management system? [What should be?];
2. What does the current Grenadian waste management system look like? [What is?]; and,
3. What could the Grenadian waste management system look like? [What could be?].

[9] 19 interviews were conducted but one was eliminated due to problems with the audio recording.

Participants were free to return to the prior pictures if something comes to mind that they would like to add throughout both the drawing and interview process. The script for the Rich Picture portion of the interview is included in Appendix 15. Following the rich picture drawing process, or if the interviewee elected to not draw rich pictures, the interviewee was interviewed using the script included in Appendix 16.

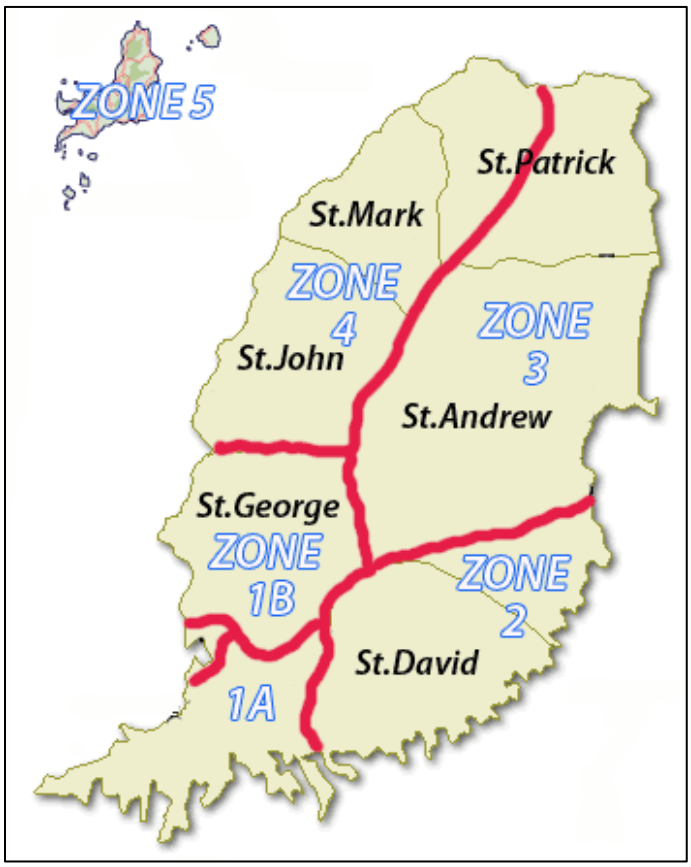


Figure 3.8 GSWMA Collection Zones (http://www.gswma.com/collection/regular/)

Citizen participants (either in interviews or focus groups) in the study were considered 'engaged' citizens; their level of concern and knowledge about waste management, their participation in environmental initiatives, and their desire for change was consider exceptional to that of the average citizen. They might be leaders in community waste management efforts, and possibly serve as important actors in future participatory or community-based waste management initiatives. Consequently, the citizens participating were not considered representative of the Grenadian population, but rather offered a perspective of an engaged citizenry.

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| # | Occupation | Age | Gender | Education | Citizenship | Parish & Collection Zone | |
|---|---|---|---|---|---|---|---|
| A | Seamstress | 50-59 | F | PS | International citizenship | Carriacou | 5 |
| B | Guest House Owner/Operator | 50-59 | F | PS | Both Grenadian and International | St. Patrick | 4 |
| C | Retired | 50-59 | F | G | International citizenship | St. George | 1B |
| D | Teacher | 30-39 | F | G | Grenadian citizenship | St. George | 1A |
| E[8] | Teacher | 30-39 | F | G | Grenadian citizenship | St. George | 1B |
| F | No answer | 18-29 | F | PS | Grenadian citizenship | St. George | 1B |
| G | Student | 18-29 | F | PS | Grenadian citizenship | St. Mark | 4 |
| H | Environmental Legal Consultant and Business Consultant | Prefer not to say | F | G | No information provided | St. George | 1A |
| I | No answer | 30-39 | M | G | Grenadian citizenship | St. John | 4 |
| J | Hotel Owner | 50-59 | F | G | Grenadian citizenship | St. David | 1A |
| K | Consultant | 40-49 | F | G | Grenadian citizenship | St. George | 1A |
| L | Tour Guide | 18-29 | M | PS | Grenadian citizenship | St. George | 1A |
| M | Marine Biologist | 30-39 | F | G | Grenadian citizenship | St. Patrick | 3 |
| N | Student | 18-29 | M | PS | Grenadian citizenship | St. George | 1A |
| O | Event Manager | 50-59 | F | G | Both Grenadian and International | St. George | 1B |
| P | Student | 18-29 | F | PS | Grenadian citizenship | St. George | 1B |
| Q | Farmer/Chocolate Maker | 30-39 | M | G | Grenadian citizenship | St. David | 2 |
| R | Food & Nutrition Scientist | 70+ | M | G | Grenadian citizenship | St. Andrew | 3 |
| S | Retired | 70+ | F | G | Grenadian citizenship | St. John | 4 |

Table 3.12 Citizen participants demographic information[10]

[10] Gender: M=Male, F=Female; Education: PS=Post-Secondary, G=Graduate or post-graduate. Copy of Information sheet in Appendix 14.

## 3.7 Government and project document analysis

Primary data was triangulated through a document analysis of legislation, waste management and environmental management plans, policies, strategies, and project documentation. A total of 137 documents were reviewed and coded. For transparency, a list of documents is available the public files of this dissertation, 'Dataset 2: Documents included in the Grey Literature corpus', and soft copies of the files are linked in the dataset. To identify documents, expert interviewees were asked about previous or existing projects, policies, strategies, and legislation related waste management and environmental management, and provided both electronic and hard copies of the documents. Some documents or activities were mentioned by the participants but not provided resources. Documents were then collected by the researcher through targeted online searches. Documentation from waste management projects, as well as other projects tangentially related were acquired through searches using keywords 'solid waste', 'waste' and 'Grenada' in the following project databases and clearing houses: World Bank Documents and Reports database, CDB Resource Library, PAHO, and USAID Development Experience Clearing House. The Organizations of Eastern Caribbean States (OECS) knowledge library was also scanned for relevant documents after searching keyword 'Grenada'. The document contents were scanned for relevancy, ensuring that 'waste' was mentioned in the document, and referred to solid waste. Documents were excluded if they referred to waste in the sense of government spending or sanitary waste and wastewater. Targeted internet searches for project, policies and strategies documentation were also conducted for the following projects that are connected to waste management outcomes (Table 3.13).

| Time duration | Project, policy, or strategy |
|---|---|
| September 1994 – January 1998 | Wider Caribbean Initiative for Ship-Generated Waste Project |
| February 2002 | OECS Solid and Ship-Generated Waste Management Project |

Table 3.13 Targeted searches for documentation

Table 3.14 presents a list of legislation impacting waste management in Grenada, including legislation that has been repealed and replaced. Copies of legislation, amendments, and Statutory Rules and Orders (SROs) were obtained from the http://laws.gov.gd/ (up until the year 2011), the https://www.gov.gd/laws-grenada website (2011-2018) and by emailing the Legislative Drafting department in the Government of Grenada. Currently, the government only publishes the current

legislation (i.e., with amendments included), therefore the Legislative Drafting department was contacted to provide specific Statutory, Rules and Orders (SROs) and amendments. Digital copies of the legislation and a hyperlinked version of Table 3.14 are available in the public files of this dissertation.

## 3.8 Newspaper analysis

Online news articles were collected from NOW Grenada, and the Grenada Informer by searching 'solid waste', 'garbage', 'trash' and 'litter' in their respective search queries. Articles were eliminated if they were not related to waste management in Grenada. For example, articles about evidence of criminal activity that was found in a garbage bin or with solid waste workers (outside of the scope of their employment) were excluded. Articles published in 2020 or earlier were included in the study. In total, 235 news articles were coded. The articles included in the study are listed as 'Dataset 3: Newspaper Articles' in the public files of this dissertation.

| Primary Legislation | Amendments to Primary Legislation and Statutory Rules and Orders |
|---|---|
| Public Health Act | Principle Act |
| Act No. 35 of 1973 - Abatement of Litter Act (Repealed) | Principle Act |
| | Act No. 10 of 1990 |
| Act No. 11 of 1995 - The Grenada Solid Waste Management Authority Act | Principle Act |
| | Act No. 30 of 1995 |
| | Act No. 8 of 2008 |
| Act No. 32 of 1993 - Trade (Non-Returnable Containers) Levy Order | Principle Act (Repealed) |
| | S.R. & O 20 of 1996 - Trade (Non-Returnable Containers) Levy Order (Repealed) |
| Act No. 29 of 1996 - Environmental Levy Act | Principle Act (Repealed) |
| Act No. 5 of 1997 - Environmental Levy Act | Principle Act |
| | Environmental Levy (Amendment) - Act No. 12 of 2000 |
| | Environmental Levy (Amendment) - Act No. 13 of 2007 |
| | Environmental Levy (Amendment) - Act No. 6 of 2015 |
| | S. R. & O. 4 of 2015 - Environmental Levy (No. 2) Order |
| | S. R. & O. 13 of 2015 - Environmental Levy (No. 2) Order |
| Act No. 16 of 2001- Waste Management Act | Principle Act |
| Act No. 42 of 2015 - Abatement of Litter Act | Principle Act |
| | Act 15 of 2018 Abatement of Litter (Amendment) |
| | S. R. & O. 1 of 2019 Abatement of Litter Act (Commencement) Order |
| Act No. 9 of 2018 - The Non-Biodegradable Waste Control Act | Principle Act |
| | S. R. & O. 18 of 2018 Non-Biodegradable Waste Control (Expanded Polystyrene) Order |
| | S. R. & O. 19 of 2018 Non-Biodegradable Waste Control (Plastic Bags) Order |

Table 3.14 Grenada Legislation impacting waste management[11]

[11] A live version of this table, including links to soft copies of the legislation is available in the public files of this dissertation

## 3.9 Positionality, biases, and data limitations

Interviews may be biased as a result of the researcher's positionality (e.g., white, non-Grenadian) and biases (e.g., possible preconceived, Western-centric ideas of what challenges exist and what 'good' waste management looks like), as well as response bias (e.g., respondents showcasing good waste management practices while downplaying challenges), and inaccuracy in recall or communicating second-hand information (e.g., a long-time duration for recall, or changes in staff without maintenance of institutional memory). These biases were mitigated through inductive coding of interviews and focus groups, and triangulation of interview and focus groups data using grey literature and newspaper articles, as well as my own observations in the field. Furthermore, interviewees had the opportunity to comment on, expand up or counter the findings from the interviews through the follow-up process.

Transdisciplinary and case-based research requires partnerships and social, relational interactions in the contexts of the research. This research is not objective and does not attempt to claim objectivity or replication because it was based on the partnership with the GSWMA and therefore, is relational. Friendships and network play a role in getting access to information, but by nature of the relationship, it may also bias the information given or bias the reception and interpretation of the information by myself, the researcher.

Small island states tend to have limited records and documentation at the state level, and this is particularly true for Grenada. Access to public archives is limited, and the public library has been closed for several years, resulting in a deficit of information available.

## 3.10 Chapter conclusion

This dissertation takes a pragmatic philosophical position, in which the value of knowledge based on its ability to serve a purpose for humanity (Moon and Blackman, 2014). I sought knowledge sources through a variety of methods and contextually situated the research in the island of Grenada (Creswell, 2014). A pragmatic philosophical framing is useful for understanding complex, wicked problems like island waste management, and supports a case-based, relationship-oriented approach to research.

The social metabolic sustainability of waste was assessed from both a biophysical, material flows perspective and the social processes that support these material flows (Section 1.3.2). Material flow

accounting (MFA), a widely accepted methodology in biophysical sciences and industrial ecology, was used to assess the waste system from a material perspective, or the 'Natural' system (Figure 1.1).

To assess the 'Social-cultural' system (Figure 1.1), a variety of sources were used to uncover governing and institutional elements and position the citizens perspective as an important contributor to waste management sustainability and governance legitimacy. The perspectives of participants were triangulated through my own observations, written artifacts like government documentation and newspaper articles. Through an inductive approach to coding all written artifacts, I was able to thematically group data to support theme generation across large and multiple sets of data.

# Chapter 4 Results: Material flows of waste

## 4.1 Introduction & chapter contributions

Understanding and quantifying the material aspects of waste management (i.e., *How much waste? Where does it go?)* is a critical first step to understanding the social metabolism of a social-ecological system. In this chapter, the results of a material flow account of Grenada's waste management system are presented. This chapter addresses the first two research questions of the dissertation (Table 1.1): Q1: *What are the material flows of Grenada's waste management system?* And Q2: *What are the material flows of problematic materials like plastics, tyres, and motor oil?* To answer these questions, I first account for the entire waste management system in Grenada, and second, quantify three problematic materials: plastics, tyres, and motor oil. This forms an important contextual contribution to Grenada's waste management as the first MFA of the waste sector in the small island state.

The results presented in this chapter makes two important contributions to the fields of industrial ecology and social ecology. First, affirming Millette et al. (2019), my study demonstrates the value of combining trade statistics with limited waste data to conduct island MFA. Collecting and maintaining waste management statistics is a challenge for small island developing states (SIDS) (UNEP, 2019a), therefore this method may be helpful for governments to better understand the material flows of their island. Second, the study demonstrates the importance of field work in waste management studies in acquiring and processing data. Accessing non-confidential, but non-publicised data would not have been possible without field work. Furthermore, when national data collection for waste management is poor, waste statistics are likely underestimated. Therefore, field work helped me to ground-truth data to understand the limitations of the collection methods. By observing waste collection, disposal, and accounting methods, I was able to understand the data limitations and gaps that remain unfilled using existing datasets from the GSWMA and Central Statistics.

## 4.2 Material flow accounting results

In 2017, the GSWMA recorded 39,044 tonnes of waste entered the Perseverance dumpsite, recorded as 'High Certainty' weigh entries (Chapter 3). Additionally, an estimated 2601 tonnes entered on Sundays and Public Holidays, classified as High-Medium, Medium, and Low estimates (Chapter 3). For Dumfries, an estimate 3771 tonnes of waste entered the dumpsite, doubling previous estimates of around 2000 tonnes (Morrison and Gray, 2017; UNEP, 2019a). Waste at

Dumfries includes waste from both Carriacou, as well as Petite Martinique. In total, the GSWMA directly managed at least 45,417 tonnes of waste (summarized on Table 4.1). This does not include 'fly tipping' received on the dumpsites without record by the GSWMA. Due to the open nature of both dumpsites, it is reasonable to assume that fly-tipping occurs on a regular basis.

Most of the waste is household (61%), while commercial and industrial make up 26% (Figure 4.1). While this study did not account for waste generation overtime, several participants suggested that consumption patterns, wants and *Americanization* of preferences were driving increases in imports and waste generation (Participant 4, 5, 7).

Observations and participants indicated that many commercial and industrial organizations use the public bins and collection services provided by the GSWMA, instead of delivering waste to the dumpsites (Participant 3, 14, 15, 25). For example, only 17 out of 38 registered hotels and guest houses[12] in Grenada delivered waste to Perseverance in 2017. Waste from cruise ship passengers[13], beaches, and parks are not explicitly accounted for in waste weight data. In Carriacou, most businesses use the public bins, and there are very few businesses that make deliveries to Dumfries (Participant 14). Consequently, commercial, and industrial waste is underestimated in recorded dumpsite deliveries.

[12] Electronic list of accommodations in Grenada was obtained from the Grenada Tourism Authority for the year 2018.
[13] Cruise ships docked in Grenada do not usually drop off waste at the Grenada port of call, reflective of the low amount of ship-generated waste that is deposited in Perseverance and Dumfries.

`

| Dumpsite | Waste Type | High | High-Medium | Medium | Low | Total Waste |
|---|---|---|---|---|---|---|
| **Perseverance** | **Co-Mingled Waste** | **28265** | **2439** | **71** | **1** | **30776** |
| | Commercial & Industrial | 5644 | 298 | 40 | 1 | 5983 |
| | Government Services | 2262 | 434 | 0 | 1 | 2697 |
| | Household | 18469 | 1661 | 0 | 0 | 20130 |
| | Institutional | 832 | 14 | 30 | 0 | 877 |
| | Ship | 232 | 8 | 0 | 0 | 240 |
| | Tourism | 826 | 24 | 0 | 0 | 850 |
| | **Segregated Waste** | **10780** | **89** | **1** | **0** | **10870** |
| | Commercial & Industrial | 2742 | 32 | 0 | 0 | 2774 |
| | Government Services | 992 | 17 | 1 | 0 | 1010 |
| | Household | 4478 | 29 | 0 | 0 | 4506 |
| | Institutional | 959 | 3 | 0 | 0 | 962 |
| | Ship | 2 | 0 | 0 | 0 | 2 |
| | Tourism | 1608 | 9 | 0 | 0 | 1617 |
| **Total waste estimate for Perseverance** | | **39044** | **2528** | **72** | **1** | **41646** |
| **Dumfries** | **Co-Mingled** | | | | **3171** | **3171** |
| | Commercial & Industrial | | | | 158 | 158 |
| | Household | | | | 2923 | 2923 |
| | Ship | | | | 90 | 90 |
| | **Segregated** | | | | **601** | **601** |
| | Commercial & Industrial | | | | 384 | 384 |
| | Government Services | | | | 217 | 217 |
| **Total waste estimate for Dumfries** | | | | | **3771** | **3771** |
| **Total waste by certainty for both dumpsites** | | **39044** | **2528** | **72** | **3772** | **45417** |

Table 4.1 Summary of waste deliveries by dumpsite, certainty of estimate and sector

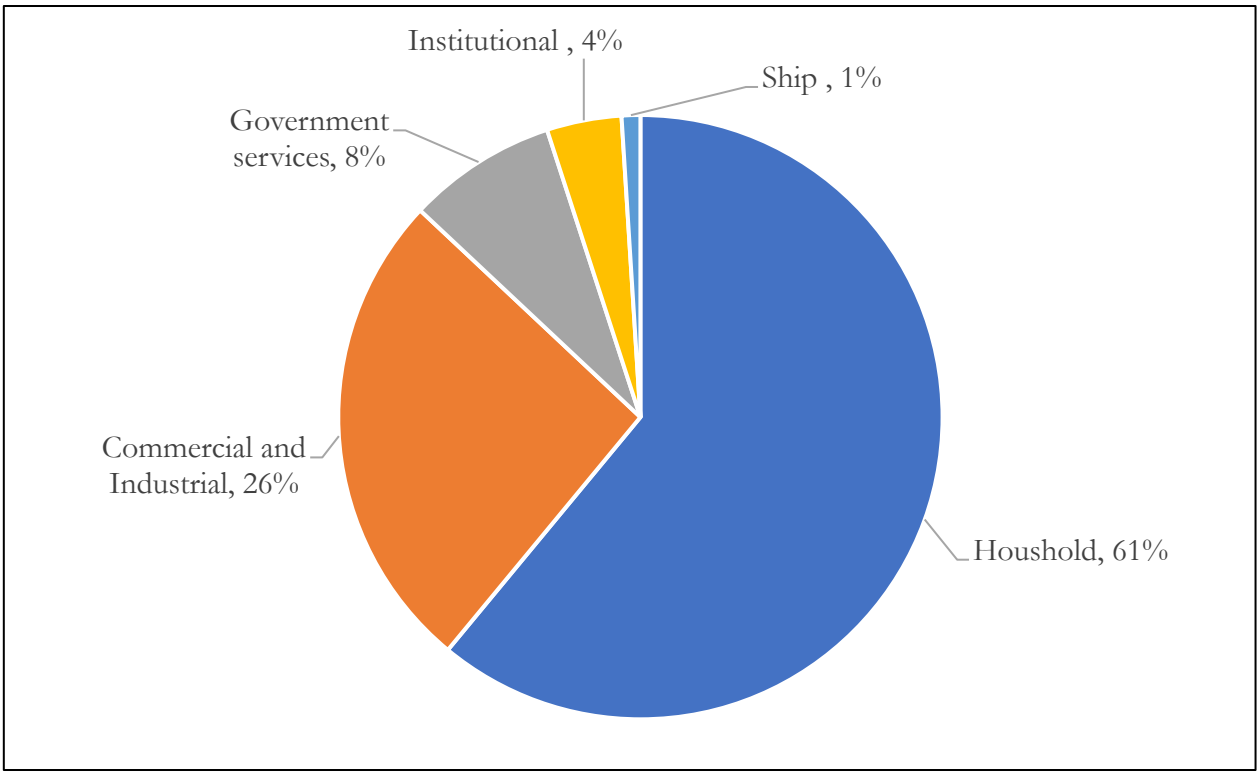

Figure 4.1 Waste by Sector

Most of the waste, 33,946 tonnes (75%) (Table 4.1), is delivered co-mingled and required waste characterization studies to determine the material contents. Segregated loads of construction materials, green waste, tyres, and white goods and electronics weighted 11,471 tonnes. Table 4.2 shows the estimated materials that arrived in segregated loads to the dumpsites. Table 4.3 presents the results of the total waste managed by the GSWMA (segregated and co-mingled) by material category for Est_1, Est_2, and Est_3.

The dumpsites accept large quantities of organic waste. For Est_1, organics with 27% make up the highest portion of waste that is delivered to Perseverance and Dumfries (Est_1). Expert participants expressed frustration with households putting out large quantities of green waste (Participant 1, 3), and coconut water vendors leaving coconut waste by the roadside for collection and deposit in dumpsites (Participant 13; Field notes, February 25, 2019). Another source of green waste is bush and greenery from the government sponsored roadside cleaning that occurs multiple times per year. Three participants indicated that there is an opportunity to work with the Ministry of Agriculture to use the green waste for another purpose (Participant 1, 3, 11). From the MFA, segregated loads of green waste from the government services equated to 1090 metric tonnes of waste or approximately 9% of the total organic waste (for Est_1, Table 4.3).

`

| Waste | Estimated waste delivered via segregated load | Percentage of segregated loads |
|---|---|---|
| Mixed Furniture | 26 | 0% |
| Food or produce | 109 | 1% |
| Vehicle | 122 | 1% |
| Paper, cardboard and polycoat | 132 | 1% |
| Lumber | 136 | 1% |
| Mixed Metal | 136 | 1% |
| Tyres | 525 | 5% |
| White goods and electronics | 505 | 4% |
| Soil | 966 | 8% |
| Green | 1826 | 16% |
| Mixed Construction | 6989 | 61% |
| Total | 11,471 | |

Table 4.2 Summary table of segregated loads of dumpsite deliveries by material type

One participant, an agronomist from the Ministry of Agriculture, suggested that Grenadian-produce compost would allow for import substitution of imported chemical fertilizers using locally available materials (Participant 11). In 2017, Grenada imported almost 407 metric tons of fertilizer (HS 31) with a stated import value of over $1 million EC (Grenada Central Statistics Office, 2017). While four participants indicated that many citizens engage in household composting (Participant 8, 11, 18 & 25), one participant also suggested that there was a need for a formal, institutionalized system, as many citizens do not have land or space to compost (Participant 11). A GSWMA employee indicated that a composting study, as part of the ISWM project, would help to understand the feasibility of a formal composting initiative (Participant 1)[14].

| Material Types | Est_1 | | Est_2 | | Est_3 | |
|---|---|---|---|---|---|---|
| | Weight | % | Weight | % | Weight | % |
| Organic materials | 12,098 | 27% | 10,728 | 24% | 16,257 | 36% |
| Paper | 4,850 | 11% | 3,999 | 9% | 8,235 | 18% |
| Glass | 2,955 | 7% | 2,838 | 6% | 3,171 | 7% |
| Construction materials | 8,239 | 18% | 9,028 | 20% | 7,664 | 17% |
| Metals, electronics, and vehicles | 4,454 | 10% | 5,327 | 12% | 3,121 | 7% |
| Tyres and rubber | 525 | 1% | 525 | 1% | 525 | 1% |
| Plastics | 4,682 | 10% | 5,969 | 13% | 4,627 | 10% |
| Plastics (Non-recyclable, non-hazardous waste) | 2,590 | 6% | * | * | * | * |

[14] At the time of writing, this study was not available for me to reference or include in the results of this dissertation.

`

| | | | | | | |
|---|---|---|---|---|---|---|
| Textiles & clothing | 2,056 | 5% | 2,369 | 5% | 1,597 | 4% |
| Hazardous | 2,967 | 7% | * | * | * | * |
| Other waste (hazardous, non-recyclable and non-hazardous) | ^ | ^ | 4,634 | 10% | 221 | 0% |
| Total | 45,417 | 100.0% | 45,417 | 100.0% | 45,417 | 100.0% |

* Hazardous, non-recyclable and non-hazardous waste for Est_2 and Est_3 are aggerated into Other Waste.

^ Other waste for Est_1 is disaggregated into Hazardous and Non-Hazardous Waste

Table 4.3 Waste managed by GSWMA by material category

An estimated additional 600-700 tonnes were littered or dumped in the environment. Table 4.4 presents the results for all three estimated by material categories, at 2% littering and dumping. For 1.5% littering and dumping estimates, see Appendix 17. This does not include organic waste, as it is assumed that organic waste is not recoverable when littered (Chapter 3), and explains why littering estimates vary by the waste characterisation study (i.e., Est_1, Est_2 & Est_3).

| | **Est_1 (2018 Aggregated by Sector)** | **Est_2 (2018 Disaggregated by Sector)** | **Est_3 (2003)** |
|---|---|---|---|
| Paper | 99 | 82 | 168 |
| Glass | 60 | 58 | 65 |
| Construction materials | 168 | 184 | 156 |
| Metals, electronics, and vehicles | 91 | 109 | 64 |
| Tyres and rubber | 11 | 11 | 11 |
| Plastics | 96 | 122 | 94 |
| Textiles & clothing | 42 | 48 | 33 |
| Hazardous | 61 | * | * |
| Non-recyclable, non-hazardous (Plastics) | 53 | * | * |
| Other waste (hazardous, non-recyclable and non-hazardous) | ^ | 95 | 5 |
| Total | 680 | 708 | 595 |

Table 4.4 Estimates of litter and dumping at 2% of waste in dumpsite

In total, an estimate 45-46,000 tonnes of waste were disposed in the dumpsites and the environment as DPO in 2017. This waste *should* have been managed by the GSWMA, based on both 1.5% and 2% littering and dumping (Table 4.5). Figure 4.2 depicts the DPO flow of 46,097 tonnes of waste based on Est_1 which includes littering of non-organic waste. These estimates do not include motor oil as it is not accepted at the dumpsites (see Section 4.5). It also underestimates the weight of metals

from vehicles, as vehicles are often abandoned by the side of the road and not brought to the dumpsites.

| **Material Types** | **Est_1 (2018 Aggregated by Sector)** | | **Est_2 (2018 Disaggregated by Sector)** | | **Est_3 (2003)** | |
|---|---|---|---|---|---|---|
| | 1.5% littering | 2% littering | 1.5% littering | 2% littering | 1.5% littering | 2% littering |
| Organic materials | 12,098 | 12,098 | 10,728 | 10,728 | 16,257 | 16,257 |
| Paper | 4,924 | 4,949 | 4,060 | 4,081 | 8,361 | 8,403 |
| Glass | 3,000 | 3,015 | 2,881 | 2,896 | 3,219 | 3,235 |
| Construction materials | 8,364 | 8,407 | 9,165 | 9,212 | 7,780 | 7,820 |
| Metals, electronics, and vehicles | 4,522 | 4,545 | 5,408 | 5,435 | 3,168 | 3,184 |
| Tyres and rubber | 533 | 536 | 533 | 536 | 533 | 536 |
| Plastics | 4,753 | 4,778 | 6,060 | 6,091 | 4,697 | 4,721 |
| Textiles & clothing | 2,088 | 2,098 | 2,406 | 2,418 | 1,622 | 1,630 |
| Hazardous | 3,013 | 3,028 | * | * | * | * |
| Non-recyclable, non-hazardous (Plastics) | 2,630 | 2,643 | * | * | * | * |
| Other waste (hazardous, non-recyclable and non-hazardous) | ^ | ^ | 4,704 | 4,728 | 224 | 225 |
| Total | 45,924 | 46,097 | 45,945 | 46,125 | 45,861 | 46,012 |
| * Hazardous, non-recyclable and non-hazardous waste for Est_2 and Est_3 is aggerated into Other Waste. | | | | | | |
| ^ Other waste for Est_1 is disaggregated into Hazardous and Non-Hazardous Waste | | | | | | |

Table 4.5 Total waste deposited in the environment (DPO) in Grenada

In Grenada, derelict vehicles are problematic as they facilitate vector breeding, they are aesthetically unpleasing, and they also can restrict road access, which can be particularly problematic in the event of an emergency or natural disaster (Participant 17). Owners may abandon their vehicles around the island due to lack of disposal options or an inability to transport to a disposal location. The Ministry of Health indicated that the GSWMA is supposed to accept end-of-life vehicles at the dumpsite (Participant 13) and observations confirmed the presences of some vehicles on GSWMA property. But, neither the GSWMA nor Ministry of Health facilitated regularized collection from the roadside (Participant 5). In 2007, prior to the Cricket World Cup being hosted in Grenada, the Ministry of Health contracted a private hauler to remove derelict vehicles from around the island; the vehicles were crushed and either stored in Perseverance or exported (Participant 13 and 17). During field work, the Ministry of Health was enforcing the Waste Management Act by posting notices on

vehicles, indicating that the owner of the vehicle must remove the vehicle; it was, however, unclear how successful this campaign was at physically removing the vehicles from the road.

Qualitatively, observations indicated that the number of vehicles (and therefore weight of materials) is significant; while the Ministry of Health indicated that there were some efforts to record the locations of derelict vehicles, I was not able to obtain official estimates. Through field work and observing a GSWMA employee, I photographed and mapped an estimated 204 vehicles (or parts thereof) that are waste reserves stored along roadsides and in communities in Grenada (Appendix 18)[15]. This vehicle count does not include large collections of 20 or more vehicles in several locations on the island which were assumed to be stocks for recycling or parts reuse. There are minimal derelict vehicles on public roads in Carriacou and Petite Martinique. From a boundary perspective, it is difficult to distinguish vehicles that became waste in 2017 compared to other years of disposal, especially given that field data was collected in 2018 and 2019. Therefore, these numbers cannot be used in an MFA for 2017 but provide evidence of the challenge related to derelict vehicles in the state of Grenada.

Table 4.6 reports the estimated amounts of ferrous metals that were removed from Perseverance in 2017 based on weights of bale records. These figures were not subtracted from the total waste (Table 4.5) due to the low certainty of the estimates. Furthermore, observations indicate that non-ferrous metals, batteries, and bottles are frequently removed from the dumpsite without being weighed, and therefore, these records are not an accurate reflection of the amount of materials removed from Perseverance.

| **Level of Certainty** | **Amount removed from the dumpsite (tonnes)** |
|---|---|
| High | 69 |
| Medium | 91 |
| Medium-Low | 24 |
| Low | 86 |
| Total | 269 |

Table 4.6 Amount of ferrous metal removed from the dumpsite

Including both wastes managed by the GSWMA and estimations of littering and dumping, Grenadians generate approximately 1.14 kilograms per capita per day (kg/cap/day). This estimated

[15] Participants in one focus group indicated that maps like these may have the potential to impact tourism, and therefore, the link for this map is not being made public but made available as a screenshot. After the culmination of field work, I became aware of the website https://www.fixmyisland.com/ that was accepting citizen reporting on island issues like potholes and illegal waste dumping.

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generation rate is significantly less than the average 2.30 kg/cap/day generation rate on SIDS as well as the Caribbean average of 2.37 kg/cap/day reported by UNEP (2019a); the data sources for the UNEP (2019a) results were not able to be verified. In comparison, the World Bank reported a global average of 0.73 kg/cap/day, Latin America, and Caribbean average of 0.99 kg/cap/day, and Grenadian average of 0.83 kg/cap/day (Kaza et al., 2018). These estimates exclude industrial, green and construction waste. In comparison, the results for household, commercial, and institutional waste to the two dumpsites equated to 36,680 tonnes or 0.98 kg/cap/day.

Evidently, waste statistics vary based on what is included and how the data is collected, implicating the importance of field work to 'ground truth' collection statistics. Furthermore, the geographical conditions of SIDS (i.e., limited land space), makes a per capita generation rate a less important indicator in comparison to total absorption capacity. In other words, islands need to consider waste accumulation and land availability, not generation rate, when assessing their sustainability.

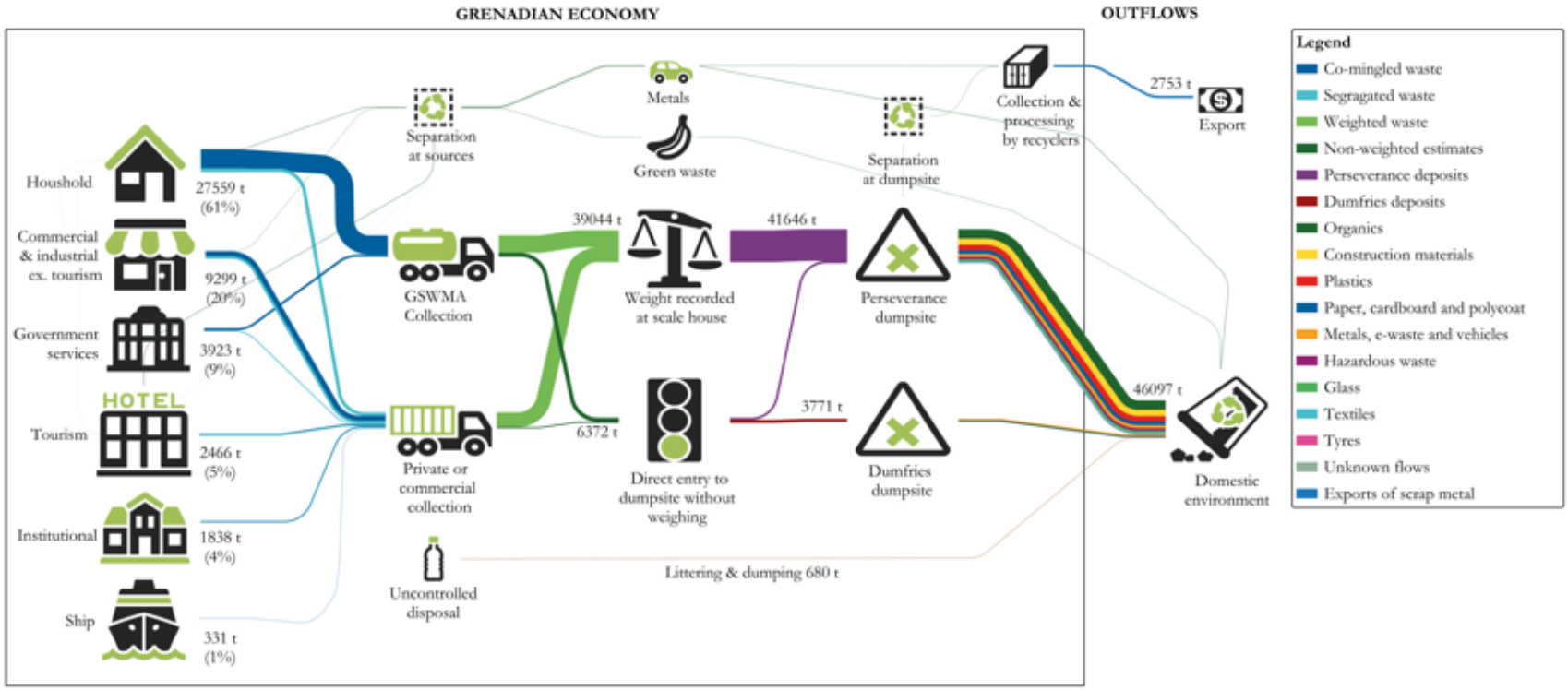


Figure 4.2 Material flows of waste in Grenada for Est_1

## 4.3 Plastics waste results

Plastic material flows using Est_1 are depicted in Figure 4.4. Grenada had a net import of up to 2642 tonnes of single-use or minimal use plastic from HS 20, 22 and 39, depicted on the left side of Figure 4.4, with exports of plastic bottles via beverage exports on the right-hand side.

Under HS 39 (Plastics), Grenada imported an estimated that 2648 tonnes of single-use or minimal-use plastics that are disposed of within one year. There were no exports of plastic products under HS 39 in 2017. Table 4.7 provides a summary of the net imports by single-use commodity under the HS 39 (See Chapter 3 for commodity classification).

Beverage containers are imported into Grenada in three formats: as containers for finished products (HS 20 and HS 22), as bottles to be filled locally (HS 3923.30.10 and 3923.30.90), and finally as preforms to be blown and filled locally (HS 3926.90.90). Preforms are concentrated PET bottles that are blown to make full PET bottles. Both unfilled bottles and preforms are included in HS 39 importation figures and are not charged an environmental levy upon importation, despite having similar environmental implications of the end-fate of the product (Government of Grenada, 2007a).

> *…with a preform. You could say the local companies they don't pay the environmental levy. So, you have a growing level of manufacturing over the years importing preforms. You blow them up into bottles. And they are still going into the environment, but they do not pay the environmental levy. (Participant 21).*

The participant suggested that preforms were not included as the government did not want to increase the costs of local manufacturing. Furthermore, when the EVL Act was first established, a number of local manufacturers were using glass bottles (Participant 21).

During field work, I was able to obtain a preform deposited in a drain in St. Georges; after cleaning, the preform weighed 14.1 grams without a lid. As the commodity code (HS 3926.90.90) does not exclusively report preforms (Participant 21), a range of 10% - 100% of the category resulted in an estimated 1.6 – 16.6 million imported preforms in 2017 at 14.1 grams. The preform dataset for these estimates is available in Dataset 1 the 'Supplementary material for Chapter 4: Material flow accounting'; this dataset includes a sensitivity analysis based on the weight of the preform (Dataset 1A) and the amount of preforms imported under HS 3926.90.90 (Dataset 1B). At 14.1 grams, an estimated 15.6 million bottles were imported under HS 3923.30.10 and 3923.30.90.

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| Products | HS Codes | Net imports | Type of product |
|---|---|---|---|
| Polymers of Ethylene | 39019000 | 0.1 | Raw |
| Polymiers of Styrene | 39039000 | 0.2 | Raw |
| **Total Raw goods** | | **0.3** | |
| Monofilaments | 3916 | 2.3 | Intermediate |
| Waste plastic | 39153000 | 0.1 | Intermediate |
| Sausage casing | 39171000 | 0.1 | Intermediate |
| Preforms | 39269090 | 234.7 | Intermediate |
| Plates, sheets, film, foil and strips of plastic | 3920, 3921 | 387.6 | Intermediate |
| Bottles (no product) | 39233010, 39233090 | 219.7 | Intermediate |
| **Total Intermediate goods** | | **844.5** | |
| Egg boxes and other boxes | 39231010, 39231090 | 504.7 | Finished |
| Bags and sacks | 39232100, 39232900 | 841.1 | Finished |
| Lids and Caps | 39235010, 39235090 | 142.6 | Finished |
| Cups | 39239010, 39239090 | 146.6 | Finished |
| Tableware | 39241010, 39241090 | 139.1 | Finished |
| Drinking Straws | 39241020 | 23.3 | Finished |
| Office Supplies | 39261000 | 6.3 | Finished |
| Spools and bobbins | 39234000 | 0.0 | Finished |
| **Total Finished goods** | | **1803.6** | |
| **Total HS 39 net imports of single-use goods** | | **2648.3** | |

Table 4.7 Net imports of HS 39 (Plastics)

Dataset 2 of the 'Supplementary material for Chapter 4: Material flow accounting' contains a sensitivity analysis based on the weight of the bottles. By not charging an environmental levy on preforms and unfilled bottles, the GSWMA is missing a multi-million dollar revenue opportunity. As illustrated in Figure 4.3, this opportunity ranges from almost $5 million - $9.5 million in potential revenue. Dataset 3 of the 'Supplementary material for Chapter 4: Material flow accounting' contains a sensitivity analysis of the revenue that could be earned from charging an environmental levy on preforms and unfilled bottles.

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| Weight of preforms and bottles | | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| Amount of preforms in HS 3926.90.90 | 10% | $ 5.1 | $ 5.0 | $ 5.0 | $ 5.0 | $ 4.9 | $ 4.9 | $ 4.9 | $ 4.9 | $ 4.9 |
| | 15% | $ 5.3 | $ 5.3 | $ 5.2 | $ 5.2 | $ 5.1 | $ 5.1 | $ 5.1 | $ 5.0 | $ 5.0 |
| | 20% | $ 5.6 | $ 5.5 | $ 5.4 | $ 5.4 | $ 5.3 | $ 5.3 | $ 5.2 | $ 5.2 | $ 5.2 |
| | 25% | $ 5.8 | $ 5.7 | $ 5.6 | $ 5.6 | $ 5.5 | $ 5.4 | $ 5.4 | $ 5.3 | $ 5.3 |
| | 30% | $ 6.0 | $ 5.9 | $ 5.8 | $ 5.8 | $ 5.7 | $ 5.6 | $ 5.6 | $ 5.5 | $ 5.5 |
| | 35% | $ 6.3 | $ 6.2 | $ 6.0 | $ 5.9 | $ 5.9 | $ 5.8 | $ 5.7 | $ 5.7 | $ 5.6 |
| | 40% | $ 6.5 | $ 6.4 | $ 6.3 | $ 6.1 | $ 6.0 | $ 6.0 | $ 5.9 | $ 5.8 | $ 5.8 |
| | 45% | $ 6.8 | $ 6.6 | $ 6.5 | $ 6.3 | $ 6.2 | $ 6.1 | $ 6.0 | $ 6.0 | $ 5.9 |
| | 50% | $ 7.0 | $ 6.8 | $ 6.7 | $ 6.5 | $ 6.4 | $ 6.3 | $ 6.2 | $ 6.1 | $ 6.0 |
| | 55% | $ 7.3 | $ 7.1 | $ 6.9 | $ 6.7 | $ 6.6 | $ 6.5 | $ 6.4 | $ 6.3 | $ 6.2 |
| | 60% | $ 7.5 | $ 7.3 | $ 7.1 | $ 6.9 | $ 6.8 | $ 6.6 | $ 6.5 | $ 6.4 | $ 6.3 |
| | 65% | $ 7.8 | $ 7.5 | $ 7.3 | $ 7.1 | $ 7.0 | $ 6.8 | $ 6.7 | $ 6.6 | $ 6.5 |
| | 70% | $ 8.0 | $ 7.7 | $ 7.5 | $ 7.3 | $ 7.1 | $ 7.0 | $ 6.9 | $ 6.7 | $ 6.6 |
| | 75% | $ 8.2 | $ 8.0 | $ 7.7 | $ 7.5 | $ 7.3 | $ 7.2 | $ 7.0 | $ 6.9 | $ 6.8 |
| | 80% | $ 8.5 | $ 8.2 | $ 7.9 | $ 7.7 | $ 7.5 | $ 7.3 | $ 7.2 | $ 7.0 | $ 6.9 |
| | 85% | $ 8.7 | $ 8.4 | $ 8.1 | $ 7.9 | $ 7.7 | $ 7.5 | $ 7.3 | $ 7.2 | $ 7.1 |
| | 90% | $ 9.0 | $ 8.6 | $ 8.3 | $ 8.1 | $ 7.9 | $ 7.7 | $ 7.5 | $ 7.4 | $ 7.2 |
| | 95% | $ 9.2 | $ 8.9 | $ 8.6 | $ 8.3 | $ 8.1 | $ 7.9 | $ 7.7 | $ 7.5 | $ 7.4 |
| | 100% | $ 9.5 | $ 9.1 | $ 8.8 | $ 8.5 | $ 8.2 | $ 8.0 | $ 7.8 | $ 7.7 | $ 7.5 |

Figure 4.3 Revenue opportunity by charging a levy on unfilled preforms (million EC$).

An estimated 27 - 44 tonnes of plastic bottles were imported with beverages under HS 20 and 22 in 2017 (Table 4.8). Grenada exported between 33-54 tonnes of plastic through bottled water exports. The net import data for individual commodities imported under HS 39, 20 & 22 are also available in Dataset 4 of the 'Supplementary material for Chapter 4: Material flow accounting', of the public files that supplement this dissertation.

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| Products | HS Commodity Codes | Estimated Weight of Packaging Imports | | Estimated Weight of Packaging Exports | | Net Weight of Packaging Waste | | Type of product | Estimate assumptions |
|---|---|---|---|---|---|---|---|---|---|
| | | Low | High | Low | High | Low | High | | |
| *Estimated weigh of plastic bottle (grams)* | | *12.0* | *20.0* | *12.0* | *20.0* | *12.0* | *20.0* | | |
| **Bottles (water)** | **22011010, 22019010, 22019090, 22021010, 22021090, 22029010** | **11.8** | **19.7** | **32.5** | **54.1** | **-20.7** | **-34.4** | **Finished** | Import quantity multiplied by average weight of a PET plastic water bottle. |
| *Number of water bottles under HS 22* | | *984648* | | *2706981* | | *-1722333* | | | |
| **Bottles (juice & other beverages)** | **2009** | **14.7** | **24.4** | **0.0** | **0.0** | **14.6** | **9.8** | **Finished** | Import quantity multiplied by average weight of a water bottle and percentage of juice assumed to be plastic (estimated at 70%) |
| *Number of juice bottles under HS 20* | | *1744905* | | *612* | | *1744293* | | | |
| *Number of juice bottles under HS 20 assumed to be plastic (70%)* | | *1221433* | | *428* | | *1221005* | | | |
| **Total HS 20 & HS 22** | | **26.5** | **44.1** | **32.5** | **54.1** | **-6.0** | **-24.7** | | |

Table 4.8 Total plastic single use from HS 20 & HS 22

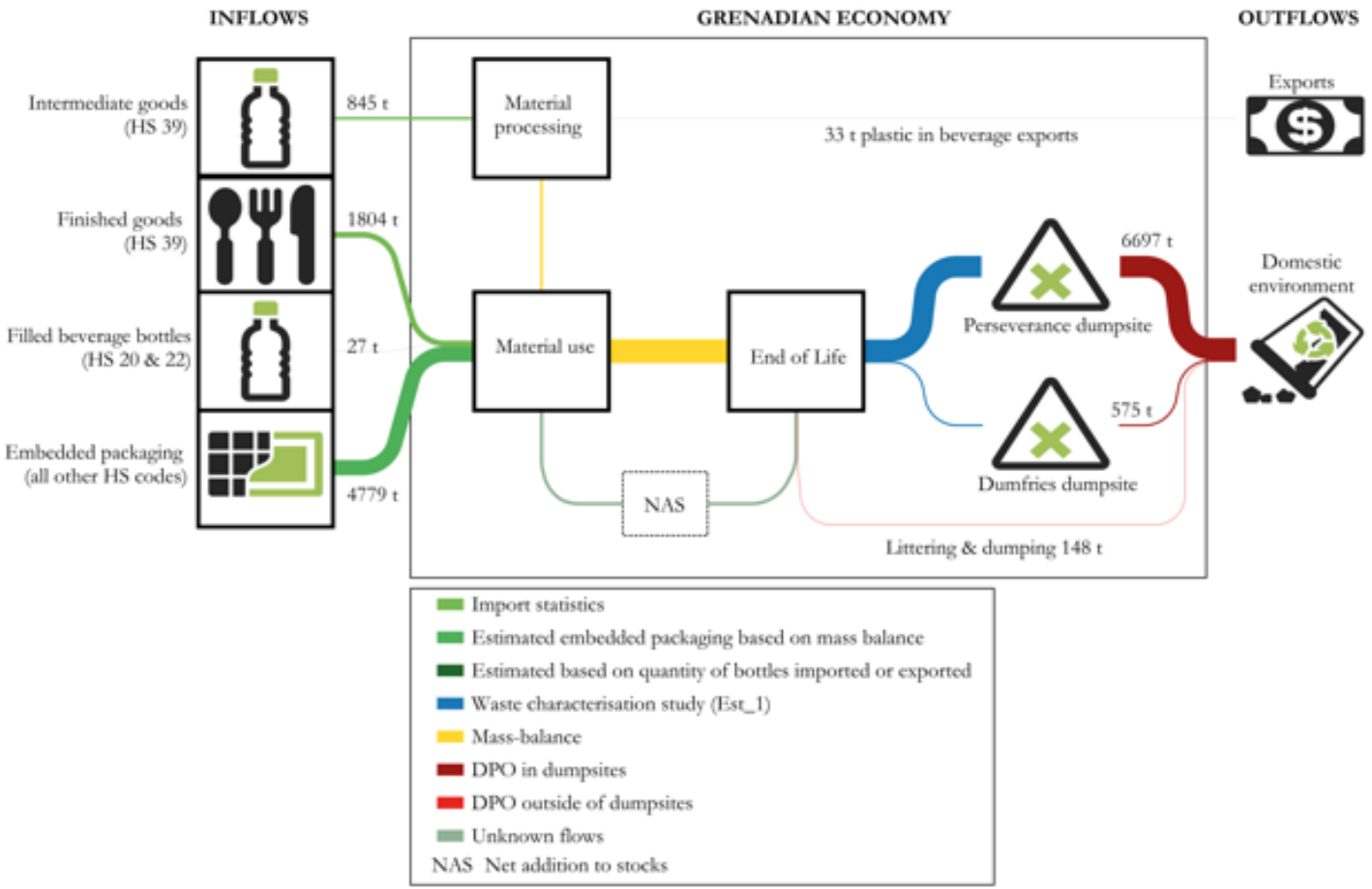


Figure 4.4 Plastic MFA

At the time of field work, one hotel had established a collection point for water bottles from a local spring water company (GlenElg). The business owner had purchased a machine, and they were chipping the bottles, but had not yet found a market for the materials; I was unable to obtain weights of bottles that were chipped in 2017 (Participant 15). Another hotel was also separating PET plastic from garbage and dropping it off at a "recycler" on the island who accepted the materials; one participant from the hotel indicated that while these materials were being separated by the hotel staff, they were confident that materials were still ending up in Perseverance (Participant 10). This assumption was confirmed by a recycler, who indicated that PET plastic was not leaving the island, as well as trade data (Participant 12).

Some plastics are indirectly imported into Grenada as embedded consumer products and packaging and cannot be accounted for in trade statistics (Participant 21, 22). Based on waste characterization data, 10-16% of waste entering the dumpsites is plastic (Table 4.3). Using Est_1, 4682 tonnes of plastic and 2590 tonnes of 'other plastic' waste entered the dumpsite (Table 4.3). Accordingly, for Est_1, a total of 7421 tonnes plastics were discarded in 2017 which includes 148 tonnes of plastic litter (Table 4.3). There is a notable difference between the amount of plastic waste that is expected to become waste based on net imports (2642 tonnes) and the amount of waste estimated based on waste characterization studies (up to 7421 tonnes for Est_1). Assuming the flows of plastic are in equilibrium (Section 3.2.3), mass-balance estimates that plastic packaging accounts for 64% of the total plastic waste or 4779 tonnes in Est_1.

Embedded packaging is depicted in the bottom left of Figure 4.4. In comparison, in Trinidad and Tobago, Millette et al., (2019) found that 55% of plastic came from embedded or indirect flows. Hopewell et al. (2009) found LDPE film and packaging made up 58% of plastic waste in the UK. As packaging and embedded plastics are not accounted for through import-export statistics, the results demonstrate how mass-balance can be used in MFA. The results for all three estimates of plastic packaging are available in Table 4.9.

To address importation of problematic materials, governments in the Caribbean have begun to restrict trade of particular products from importation (UNEP, 2019b). Recently, the Government of Grenada enacted legislation banning the importation of select non-biodegradable products, including polystyrene (Styrofoam) food containers and handled shopping bags (Government of Grenada, 2018b). Furthermore, the government has plans to ban plastic cutlery and straws (Participant 18) in the near future; another participant indicated that there are also plans to deal with

plastic bottles (Participant 22). Consequently, these specific results can help to develop a baseline to understand material impacts of banning materials.

| | Est_1 (2018 Aggregated by Sector) | | Est_2 (2018 Disaggregated by Sector) | | Est_3 (2003) | |
|---|---|---|---|---|---|---|
| | Weight at 1.5% littering | Weight at 2% littering | Weight at 1.5% littering | Weight at 2% littering | Weight at 1.5% littering | Weight at 2% littering |
| **Waste at dumpsite** | 7273 | 7273 | 5969 | 5969 | 4627 | 4563 |
| **Waste in environment** | 111 | 148 | 91 | 122 | 109 | 146 |
| **Total plastic waste (DPO)** | 7383 | 7421 | 6060 | 6091 | 4736 | 4709 |
| **Net plastic imports** | 2624 | 2642 | 2624 | 2642 | 2624 | 2642 |
| **Embedded Plastics** | 4760 | 4779 | 3436 | 3449 | 2112 | 2066 |
| **Embedded plastics as % of all plastics** | 64% | 64% | 57% | 57% | 45% | 44% |

Table 4.9 Embedded plastic packaging

## 4.4 Tyre waste results

The demand for mobility that has led to an increased importation of motor vehicles and components like tyres and motor oil. Throughout field work, people mentioned that traffic had become congested on the island, and observations confirmed that, particularly in the southern tourist area, traffic jams were a common occurrence. Data acquired from the Central Bureau of Statistics (CBS) confirmed growth in total vehicle registrations (Figure 4.5A), with most new registrations being used vehicles (Figure 4.5B). Estimated vehicle stocks grew from 14,800 in 2000 to 38,180 in 2017[16]. Several participants indicated that end-of -life vehicles, tyres and motor oil waste had become problematic waste stream on the island (Participant 1, 5, 13, 17, 19, 22).

> *We have a big problem with disposal of motor vehicles. A lot of used vehicles imported from Japan, …. Now we know vehicles have , they have a lifespan. So when their lifespan has ended, what happens to them? And there are so many vehicles in Grenada now, so what happens to them? (Participant 19)*

[16] Dataset obtained from the Central Bureau of Statistics indicated that vehicle stocks are estimated to be 80% of the vehicle registrations in a given year.

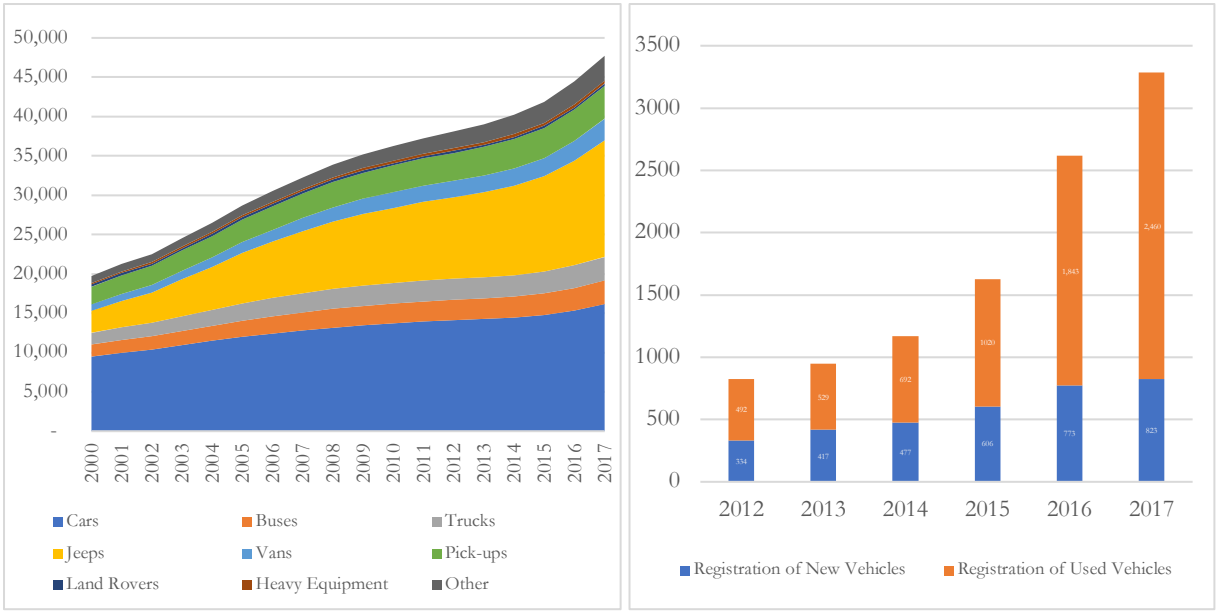


Figure 4.5 Demand for mobility leading to imports of vehicles

A) Total vehicle registrations by vehicle type, *Source: Central Bureau of Statistics* B) New vehicle registrations recorded by importation status (new or used, *Source: Central Bureau of Statistics and Inland Revenue*

This mounting pressure was also evident in the accumulation of tyres at the Perseverance dumpsite, as well as in illegal or informal dumping sites around the country. Used tyres, while more affordable, quickly become waste, and a number of participants indicated that used tyre imports created a waste management problem (Participant 3, 5, 6, 7, 11, 12, 13, 14, 18, 21, 22, 23, 26; Focus Group 1).

> *As you may notice if you go by our landfill [Perseverance dumpsite] you will see that we have a huge problem with tyres. This is a challenge to manage … and especially the used tyres that become waste so soon after being imported into the island…. It's just alarming. (Participant 3)*

Grenada imports more used tyres than new tyres. In 2017, Grenada imported 732 tonnes of used and 594 tonnes of new tyres, visible on the left side of Figure 4.6. It is assumed that the system is in equilibrium and every tyre imported replaces a tyre in stock. In other words, tyre stocks increase with imports of vehicles that include tyres, not tyre imports. Therefore, an estimated 1326 tonnes of tyres reached the end of their useful life in 2017. Notably, there is a Tyre Standard that controls the quality of the tyres imported into Grenada. The standard does not address any particular disposal method at end of life, but if tyres do not pass inspection by the Bureau of Standards at importation, options for disposal are re-export or destruction (Participant 23).

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Weight records indicated that 500 tonnes of tyres were delivered to Perseverance in segregated loads. At the time of field work, tyres were being stock piled in an area separate from the main dumpsite. The GSWMA owns a tyre shredder to reduce the volume of waste, but at the time of field work, the shredder was not operating due to a dull blade (Figure 4.8 B) Whether tyres are shredded or not, the materials are deposited in the dumpsite (Participant 6, 7).

> *Tyres don't go anywhere... We shred them. They were like this (gesturing a big space) and they become like this (gesturing a smaller space), and it stays like that forever. [Myself: "and then it goes to the dump site?"] We don't have a choice; we have to put it somewhere. I know burning is a no-no. And management sees burning as a no-no. And you as an environmentalist, I think you will see it as a no-no. But the question is, what do you do with it? (Participant 7)*

I estimated that 25 tonnes of tyres are disposed in Dumfries[17]. Tyres are subject to illegal dumping in Grenada, therefore I estimated that 11 tonnes of tyre were disposed in the environment. In total, an estimated 536 tonnes of tyres were disposed of in the dumpsites and environment in 2017.

Tyres are repurposed as stocks in planters (Figure 4.7 A), cultural displays and infrastructure development (Figure 4.7 B). Consequently, from the 1326 tonnes of imports, some 536 tonnes are deposited as solid waste DPO and the remaining are stock additions (e.g., used as a display for plants) or become DPO through burning to facilitate bamboo or tree clearing (Participant 6, Focus Group 1). One participant at the GSWMA suggested that tyres have the potential to flattened and cut into shingles for roofs on houses (Participant 6).

[17] Carriacou and Petite Martinique are about 5% of the state of Grenada's population.

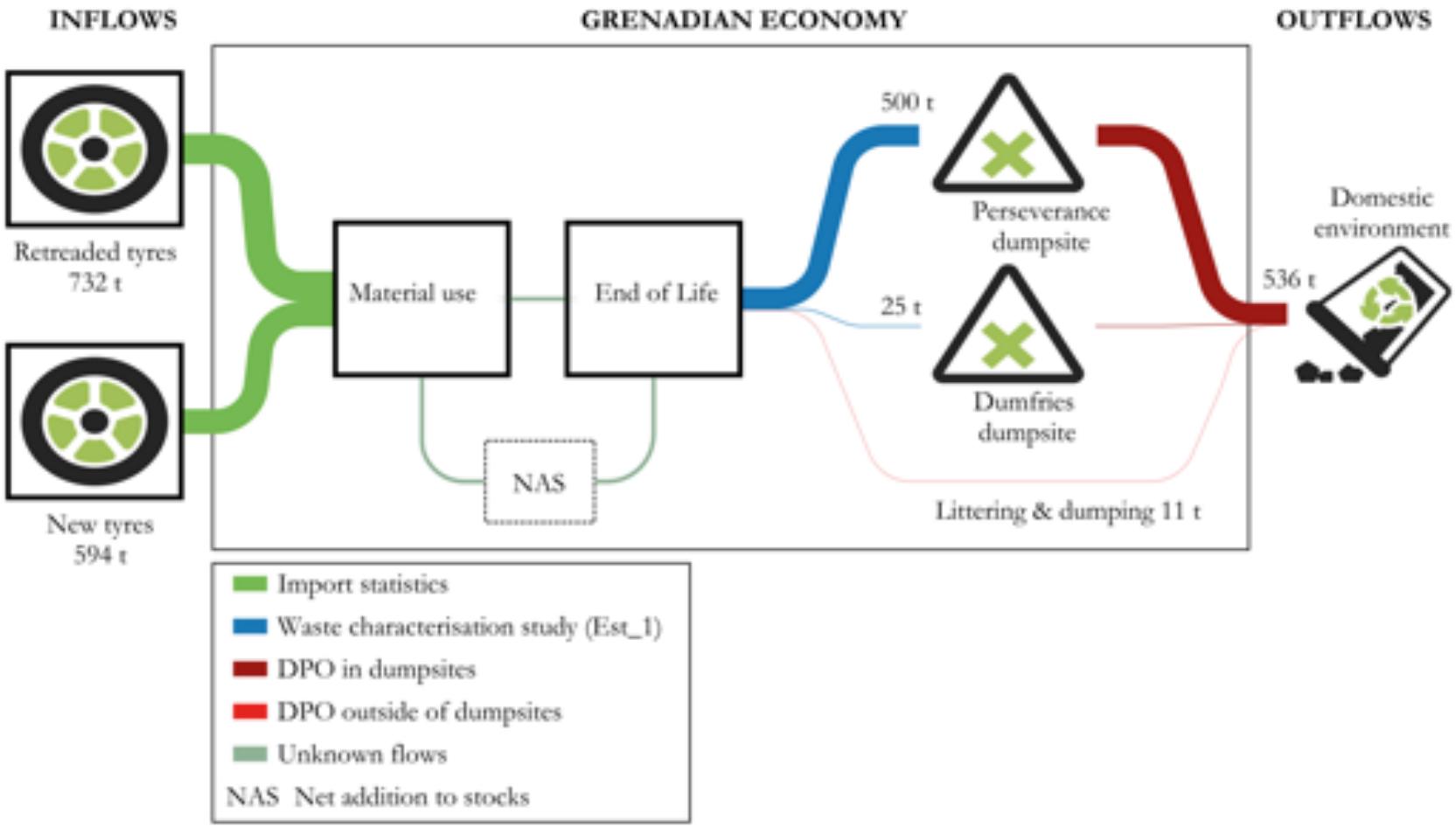


Figure 4.6 Tyre MFA


Figure 4.7 Examples of tyre repurposing
A) Planter, March 8, 2019, B) Embankment and cultural display, January 23, 2019

Figure 4.8 Tyres a Perseverance dumpsite
A) Tyre pile, November 19, 2018; B) Tyre shredder at Perseverance dumpsite, April 10, 2019

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## 4.5 Motor oil results

Used motor oil is not accepted at dumpsites and there is no institutionalized collection, disposal, or recycling program in place, despite being legislated to develop a used motor oil plan (Government of Grenada, 2001). Participants indicated that no one in Grenada currently had a plan to deal with used motor oil (Participant 2 and 12).

> *It's a really bad pollutant and it's getting into the water table. If you go and look around Grenada, you'll see barrels and barrels of this stuff. Nobody knows what to do with it. Ground saturated with it behind every house where someone owns a car. You'll see a whole where people pouring it into the ground. It's the worst pollution problem in Grenada. (Participant 2)*

One participant indicated that there are numerous technologies in which used motor oil could be reprocessed into diesel fuel or usable motor oil (Participant 12), and this was mentioned as an entrepreneurial activity by the GSWMA (2020a). Furthermore, garages would be willing to pay for disposal, and reprocessing, as they currently charge their customers a disposal fee (Participant 12). Another participant indicated that garages were willing to pay for transportation costs of used oil for processing at the Protein from Waste factory (Participant 2). When in operation, the Protein from Waste project was using 15% of the islands used motor oil as fuel to process fish and brewers waste into chicken feed (Participant 2), but this factory was not operational at the time of field work.

The material flows of used motor oil are depicted in Figure 4.9. In 2017, Grenada imported 582 tonnes of lubricating oil in 2017. An estimated 18% of oil dissipates through leaks, spills, and auto-combustion during consumption (Kuczenski, Geyer, Zink, & Henderson, 2014). This resulted in 477 tonnes of motor oil reaching end-of-life in 2017 (Figure 4.9). An expert at the Ministry of Health indicated that at one point the GSWMA was collecting motor oil but ultimately the tank was too small and was simply for appearances (Participant 17).

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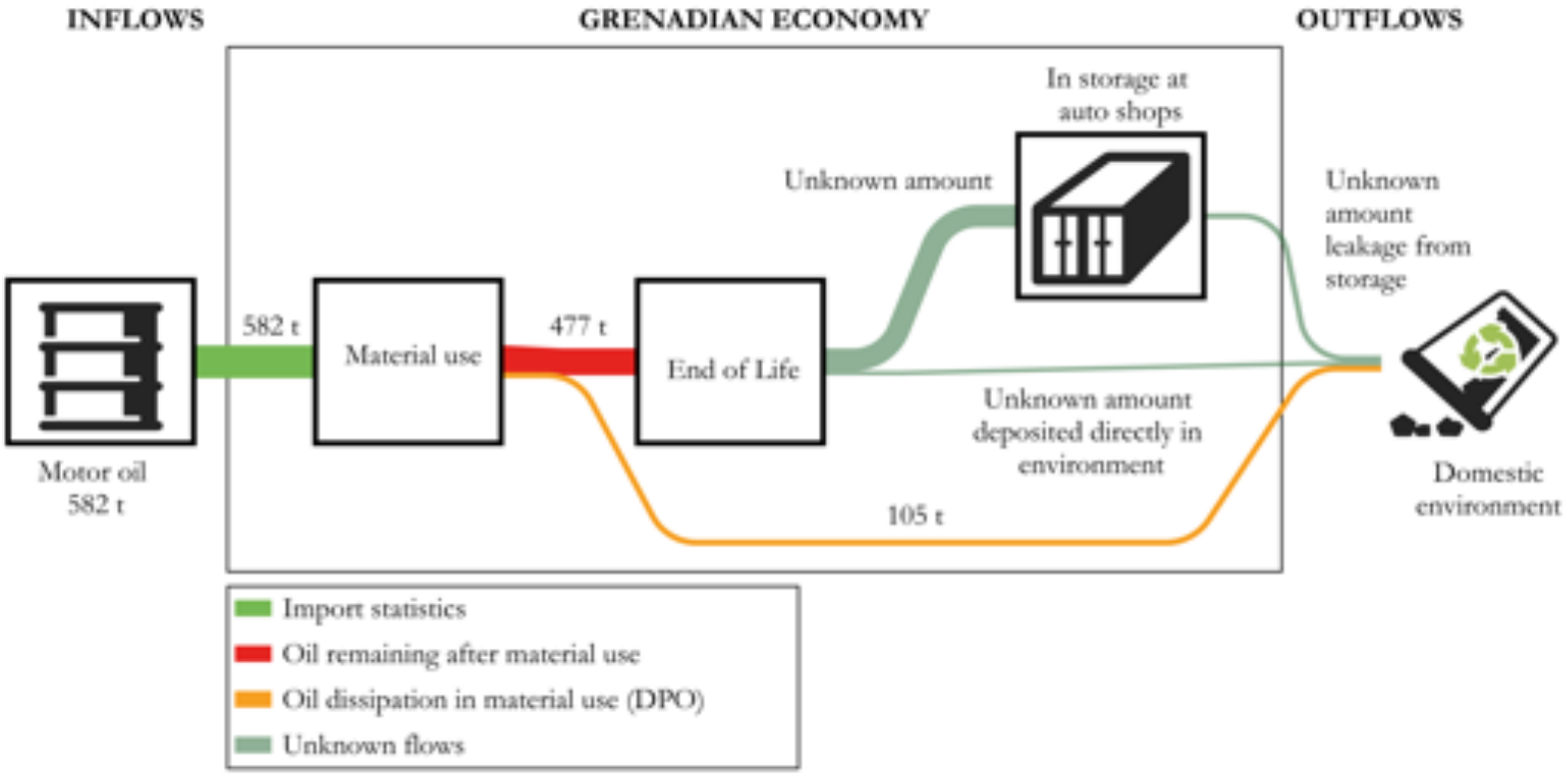


Figure 4.9 Motor oil MFA

Figure 4.10 Motor oil informal storage
A) Storage in drain, adjacent to roadside garage, March 6, 2019, B) Storage at Pearls Airstrip, April 15, 2019.

It is unknown how much of this oil remains as a collectable waste (i.e., held in barrels at shops and businesses) and how much leaks into the environment (Figure 4.10). Observations indicate that motor oil leakage into the environment is pervasive: automobile shops store in drums that leak; oil is buried as a means of disposal; drums of motor oil are abandoned; motor oil is used during the Carnival, transferring into the environment; and oil is used to mark boundary lines on playing fields and running tracks in Carriacou (Field Note, February 19, 2019). To illustrate, Figure 4.10 B displays a collection of oil drums at the Pearls Airstrip, of which I counted at least 56 barrels (Field Notes, April 15, 2019). Grenada did not export any used motor oil for processing in other economies in 2017.

## 4.6 Chapter conclusion

This study is the first comprehensive MFA of Grenada's waste management system. This chapter accounts for the material flows of waste, specifically the problematic materials of plastic, tyres, and motor oil. The account demonstrates the importance and value of measuring and assessing waste management systems quantitatively as a first step to assessing an island's social metabolism. Governance actors, particularly policy makers, *cannot manage what they cannot* measure, therefore sound data is critically important to guide transitions to sustainable waste management systems. Material

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flow accounting is one such means for waste managers and policy makers to assess their sociometabolic risk and understand the resource potential of waste materials.

Importantly, however, materials do not just flow on their own: they are driven by institutional elements like legislation, regulation, policies, normative positions and engrained social habits that are culturally supported (Scott, 2013). Through understanding the flows of waste, I was able to identify how coercive, regulatory institutions (i.e., legislation, regulation, and policy) impacts waste accumulation, and therefore, sociometabolic risk. In Chapter 5, I present the results of an analysis of Grenada's governance system that guides the material flows of waste.

# Chapter 5 Results: Governance challenges

## 5.1 Introduction & chapter contributions

Over the course of three-to-four decades, the GSWMA has made monumental gains in the collection of waste. But the focus on collection and the (unsuccessful) development of landfills[18] has put pressure on the surrounding environment and human health. The problems related to environmental pressures and human behaviour are evident, and widely documented. Yet, the responses to these challenges (e.g., inappropriate technology, reliance on external consultants, lack of enforcement of existing legislation, and loopholes or legislative gaps) have failed to provide a solution to a mounting waste management problem.

This chapter addresses the third research question, Q3: *What are the implications of governing systems (institutions, legislation, and policy) and actors on the material flows of waste in Grenada?* In addressing this question, I contribute to a contextual understanding of the waste governance in Grenada. Additionally, this research contributes to understanding governance and institutional aspects of the sociometabolism framework (Figure 1.1) within the social-cultural sphere. This chapter helps to identify *how* and *why* Grenada's waste management system continues to demonstrate sociometabolic risk.

The results demonstrate that Grenada has a legacy of implementation and institutional challenges related to a project-based, end-of-pipe approach that has failed to deliver adequate waste management. One participant indicated that waste management in Grenada runs project-to-project – when the system collapses, waste management restarts from scratch and reverts back to bad habits (Participant 17). Consequently, projects have experienced a crisis in legitimacy, in which efficiency of service delivery is absent. Furthermore, current governance mechanism and institutions are lacking comprehensive coverage, and are outdated, absent or inadequately enforced. This governance gap is reinforced by lack of data for decision-making; sound resource management and waste management cannot be realized in the absence of meaningful data that is used to make and implement good policies, processes, and practices and to monitor the results. Finally, both data and engagement with global and regional governance mechanisms, such as multi-lateral environmental agreements focused

[18] At the time of writing this dissertation, Grenada was in the process of rehabilitating and developing an additional cell at the Perseverance landfill location.

on pollution, can provide both motivation and capacity for implementing governance mechanisms at the national scale.

## 5.2 Legacy of past governance challenges

The Grenadian government's and the GSWMA's response to waste management pressures have been largely 'end of pipe'. Documentation and current practices demonstrate a bias for collection (i.e., efficiency and coverage of service) and disposal methods, like developing landfills and contemplating waste-to-energy and incineration (Government of Grenada, 2011b). There is strong evidence of an implementation gap. The government and the GSWMA talk about the need for diversion, including recycling and composting, and 'proper' landfill management; but governance measures have not yet been put in place to realize standards, procedures, and methods to reduce waste through diversion, as per the Waste Management Act (Government of Grenada, 2001, sec. 5(3)) and the strategies in the National Waste Management Strategy (Government of Grenada, 2003)[19]. The strategy notes that Dillion Consulting conducted an evaluation of waste diversion opportunities in Grenada and reported the findings in '*Final Project Report and Addendum, Regional Waste Reduction, Recycling and Reuse Strategy and Action Program, September 1999'*. I was not able to acquire a copy of this report during the research; however, the strategy contains a list of prioritized diversion actions from this report, which are listed in Appendix 19.

There have been numerous attempts to transition Grenadian dumpsites to sanitary landfills. In 1984, following the US invasion, the Ministry of Health requested help from USAID/Project HOPE to assist in providing health care, including addressing the solid waste problem. The Perseverance dumpsite was upgraded to a sanitary landfill, and equipment and vehicles were purchased to improve the collection of refuse (Government of Grenada, 1995b; USAID, 1984). The effectiveness of the landfill, however, shortly declined, and "deteriorated once more to an unsanitary open dump" (The Caribbean Conservation Association, 1991, p. 179). The government of Grenada attributed this decline to budget constraints that inhibited acquisition of parts and ongoing maintenance of the landfill infrastructure (The Caribbean Conservation Association, 1991).

Under the aegis of the OECS and the World Bank and other global funders, and in response to MARPOL 73/78, the Government of Grenada, and the newly formed Grenada Solid Waste

[19] The National Waste Management Strategy for Grenada defines waste diversion as "any environmentally sustainable initiative that decreases the quantity of waste that must be landfilled or incinerated." (Government of Grenada, 2003, p. 19).

Management Authority participated in two projects addressing ship-generated and solid waste. Two sanitary landfills were developed at existing dumpsite locations, Perseverance in Grenada, and Dumfries in Carriacou in 2001 (PAHO, 2004). The outcomes of this project were ranked *highly satisfactory* by the World Bank (2003a). Unfortunately, in late 2001, heavy rains caused a landslide in the Perseverance landfill, rendering the new sanitary landfill inoperable and causing the GSWMA to revert to using the 'old dumpsite' adjacent to Halifax Harbor (Participant 1). One participant indicated that the engineers hired to build the landfill were not experts in this sector, and likely did not account for water discharge rates (Participant 17). An evaluation of Grenada's waste management system in 2004 indicated that repairs to the cell had been "delayed by the need to assess the causes of the landslide in mitigated measures required to prevent a reoccurrence" (PAHO, 2004, p. 6). Despite the setback related to the landslide, documentation indicated a level of optimism of the state of landfill management with "…open burning and pest infestation eliminated completely" and the promise of benefits from a "much improved disposal facilities when the new Perseverance landfill site comes into use" (PAHO, 2004, p. 6; The World Bank, 2003a).

There is less clarity about the events leading up to the demise of the sanitary landfill in Carriacou, as there is limited institutional memory or written reporting on the subject. The Dumfries site has been in use since 1999 or 2000 (WSP Caribbean Limited, 2018b) One participant recalled that there was a sanitary landfill constructed at the Dumfries site in the early 2000s; this system was designed to drain and recovery leachate (WSP Caribbean Limited, 2018b). Unfortunately, as a sanitary landfill, the system only operated for approximately one year due to failure of the leachate circulation system (Participant 14).

In 2004, Grenada was struck by Hurricane Ivan which devastated the island. This, without a doubt, contributed to delays in landfill rehabilitation at the Perseverance site, as the GSWMA was charged with clearing, collecting and storing debris waste.

By 2009, the GSWMA had issued a request for bids from consultants on the project *"Perseverance Landfill Design, Dumpsite Closure and Solid Waste Reduction and Disposal Strategy"*. There is limited information on the proposal or outcomes of this project, apart from several hard copies of financial proposals observed at the GSWMA office. One participant indicated that an engineering firm was hired to conduct a survey on rehabilitating Perseverance and conducting an Environmental Impact Assessment, but the resultant report was not available (Participant 17). Observations suggest that the outcomes of the project, (i.e., rehabilitating the landfill and closing the dumpsite), were not fulfilled.

Consequently, despite significant effort and funding over the course of three decades (1984-2020) to 'modernize' Grenada's waste management open dumpsites to sanitary landfills, Grenada continues to rely on unsanitary dumpsites to dispose of waste. At the time of writing, contractors hired by the GSWMA were in the process of building a sanitary landfill and rehabilitating the first cell at the Perseverance site. This landfill, however, is only planned to last 3-5 years once completed (Participant 1, 3, 5) (GSWMA, 2020b). One participant from the GSWMA indicated that the scope of the ISWM project was not well-thought out, as they were planning on building a landfill without diversion plans in place. In other words, the GSWMA via the ISWM project has 'put the horse before the cart'.

> *… if we want to promote waste diversion, if we want to promote reuse, or want to promote … you know, production of less garbage or whatever it is… these are stuff that would probably come before you have the construction of a landfill where you going to have, just going to dump co-mingled waste in. (Participant 1)*

This demonstrates lack of systematic thinking, as well as implementation of a basic waste hierarchy within the GSWMA operations, at the time of field work.

The ongoing landfill development and struggles illustrates the GSWMA's reliance on outside funding and external consultants to do the major 'plans' for the Authority. Almost all the documented strategies and plans for waste management in Grenada were written by external consultants. While the GSMWA may write the Terms of Reference, they ultimately rely on strategies and plans that they have no ownership over. To date, there is little to no sustained implementation of the waste management strategy from 2003. The Waste Management Act (Government of Grenada, 2001) legislates that the strategy should be redeveloped and evaluated every 5 years, but to my knowledge, a new strategy has not yet been updated or published.

Several participants indicated that diversion and waste management technology and equipment experience frequent breakdowns (Participant 1, 3, 4, 7, 13; Focus Group 1). Most notably, the sanitary landfill at Perseverance remains inoperable to this day. The incinerator at the General Hospital in St. George's was cited as being ineffective at properly processing biomedical waste (Participants 13, 17, 18; Focus Group 1). One participant indicated that the metal baler had recently started working (Participant 7), but it had been down for some time (Participant 7, 17). Observations indicated that the tyre shredder at the Perseverance dumpsite is frequently inoperable due to dull

blades; despite being recently purchased, replacement blades were deemed financially out of reach for the Authority. The hospital in Carriacou was no longer able to operate their incineration furnace due to spare parts are no longer available (WSP Caribbean Limited, 2018b). One participant from the GSWMA indicated that the frequent failure of technology makes the GSWMA afraid to invest in additional diversion equipment.

> *We have a tyre shredder and we have a baler. Those were new technologies that they brought in and in some ways… they are almost failing technologies because they breakdown so frequently. The fear of having something at a larger scale that would come and sit, and just [not] work. That's a limitation as well. (Participant 4).*

Furthermore, economies of scale and lack of financing were identified as limitations to implementation of diversion technologies like recycling (Participant 2, 3, 4, 15, 18). For example, the GSWMA was concerned about investing in separation and baling systems from plastic, when the market for exporting plastics was unpredictable (Participant 1). Other participants indicated that for a recycling operation to be economical, they needed more plastic, not less (Participant 3, 15). Consequently, this suggests that many diversion technologies were deemed unaffordable for the island, in absence of outside funding.

The government is vague on implementation details of future diversion options. For example, the National Sustainable Development Plan indicates that Grenada needs to "establish structures and arrangements to promote sustainable waste management and disposal" but stops short of describing what that entails (National Plan Secretariat, 2019, p. 85). Furthermore, the goal to "upscale investments in waste-to-energy and recycling facilities to improve the sustainability of Grenada's waste (solid and liquid) infrastructure" seems to imply that there are existing waste processing facilities at a national level (National Plan Secretariat, 2019, p. 87). In similar vein, the Government of Grenada frequently uses "sanitary" and "landfill" to describe the Perseverance and Dumfries dumpsites. For example, the government reported to the UNFCCC that the country had two *operational* landfills that replaced open dumping in 2001 (Government of Grenada, 2012a). On the GSWMA's website, the description of waste management in Grenada indicates that several open dumpsites were closed and rehabilitated (GSWMA, n.d.). Documents describing waste management procedures and concern for infrastructure projects are often misleading, vague, and not cognizant of the realities of waste management in Grenada. For example, the government references landfills,

licensed collectors, and solid waste policies and regulations in documentation from the Regional Disaster Vulnerability Project.

> *Liquid and chemical wastes will be stored in appropriate containers separated from the general refuse; all waste will be collected and disposed of properly in* ***approved landfills*** *by* ***licensed collectors*** *(Government of Grenada, 2015b, p. 43).*
>
> *The contractor(s) shall provide the contracting officer with a trash and debris management plan that conforms to the* ***solid waste management policies and regulations*** *of Grenada (Government of Grenada, 2015b, p. 43).*

At the time of the Regional Disaster Vulnerability Project however, Grenada did not have a functioning sanitary landfill. Furthermore, to my knowledge, there has not been any implementation of the Waste Management Act as far as policies and regulations (Section 5.3.6), and the Ministry of Health was not licensing contractors, or if contractors were being licensed, it was not only licensed haulers bringing waste to the dumpsites.

Consequently, while the "focus" may be on end-of-pipe options, like landfills, incineration and recycling, waste management initiatives in Grenada have suffered from lack of implementation of basic waste management practices, as well as systems-based thinking. One participant illustrated the importance of looking at both technology and *more importantly* the cause of waste generation:

> *Perseverance dumpsite is almost.... to its capacity. You know, how do we how do we incorporate modern technology and modern systems? But… more importantly, how do we look at the factors that are contributing to the generation of all this waste? You know, and how could we could we deal with some of these factors, addressing, ... the cause... (Participant 22)*

In 2020, the GSWMA celebrated 25-years of operations through a new logo and publication of a newsletter, amongst other public events. The excerpt below suggests that the Authority is interested in taking a systemic approach by addressing the 'inflows' of waste (i.e., source reduction, consumption and production) and transitioning to a resource management mindset, through resource recovery. Currently, however, the GSWMA lacks the internal funding mechanisms, policies, regulation, and enforcement of laws to make it happen.

> *To manage the waste that is generated in Grenada we must look at source reduction, that is looking at every member of the population being responsible for their own waste and reducing what we call*

> *the per capita generation of waste. The consumption and production patterns of Grenadians must be adjusted, that is a very tall order and will need to be done through continuous education, policy, legislation, and voluntary compliance.* ***With the construction of the new cell for landfilling at Perseverance landfill facility, we are hoping that in 2021 we would be transitioning from waste management to resource recovery****. Based on our current waste stream we would be able to recover approximately 80% of the waste that is generated once there is a structured recycling program and integrated resource recovery center in place. We are currently seeking assistance from international development partners to make that transition from waste management to resource recovery. (GSWMA, 2020b)*

This vision demonstrates a notable shift in thinking at the GSWMA, from a vision of a scientific landfill to resource management; it also aligns with recommendations from the National Waste Management Strategy, which called for the GSWMA to broaden its scope of priorities to include waste minimization (Government of Grenada, 2003). Following field work for this dissertation, the GSWMA created a new position of 'Integrated Resource Manager'; this position is responsible for championing recycling initiatives and innovative waste management practices, with requisite revisions of the environmental levies, legislation, and regulation to match the vision of resource management (Personal communication, Participant 4, 2021). Notably, in the National Waste Management Strategy, consultants outlined a draft job description for a 'Waste Diversion Officer' (Government of Grenada, 2003), and this new position aligns with the existing description. This vision recognizes that landfilling is not a resource recovery strategy. So, while waste management operations to date have focused on end-of-pipe 'solutions', the GSWMA is beginning to recognize that the governance structure needs to align with a new systems-based, resource management vision. The next section presents results related to the current waste governance system.

## 5.3 Grenada's current waste management governance

Grenada's current waste governance system is inadequate to facilitate the desired resource recovering mindset. Grenada's waste management system is limited by lack of comprehensive environmental management legislation, land-use planning and environmental protection; lack of clear responsibilities for environmental management; outdated or inadequate legislation and lack of enforcement of existing legislation; lack of data to support environmental decision making; and, lack of participation in global governance frameworks that provided guidance and funding for sound waste management and resource management initiatives.

### 5.3.1 Comprehensive environmental legislation

The National Land Policy (Draft) states that "sustainable management of natural resources can only be achieved: a) with access to sound information and data concerning such resources; b) when fully integrated into Grenada's fiscal, physical and infrastructure planning development process; c) when supported by enabling legislation." (Government of Grenada, n.d.)

Grenada does not have comprehensive environmental and resource management legislation (Government of Grenada, 2015b, n.d.; Jeco Caribbean, 2011). In 2005, Grenada drafted an Environmental Management Act (EMA) (Government of Grenada, 2005)[20] which aligns with model Environmental Management Legislation from the OECS (2007). This legislation is focused on pollution control, with updates suggested in the Draft Land Use policy to include the establishment of the legal and administrative framework for natural resource management (Government of Grenada, n.d.). Neither the draft EMA nor the draft Land Use policy have gone to cabinet (Participant 9, 24). In 2007, there was indication that the draft EMA was being revised with a goal of approval for the 2007 budget (OECS, 2009). From the data, it is not clear why there is continued delays in enacting this legislation, but it is cited as critical legislation for addressing several concerns, including land use planning, land and marine management, and biomedical waste management (Government of Grenada, n.d.; Jeco Caribbean, 2011; World Bank, 2009). Furthermore, the draft EMA addresses several aspects relevant to improving waste management: the polluter pays principle, the collection of environmental data and access to information, and the importance of environmental impact assessments for developing infrastructure for waste management activities. Participants indicated that Grenada has drafted a lot of environmental management legislation, regulation, and policies, yet most of them do not make it to Cabinet or Parliament for enactment or sign off, and therefore are not promulgated or made available for the public (Participant 9, 24 & 26) (UNEP, 2010).

During field work, I observed a reactive approach to environmental problems in waste management. The most illustrative example is putting out fires while continuing to allow organic waste (i.e., a source of methane gas) to be dumped in the burning dump site. This was reinforced by a participant in the study, who stated:

[20] A copy of the legislation was not accessible via the government, but I was able to obtain a copy from https://www.elaw.org/caribbean/laws.

> *… everything goes down into the river, everything goes into the ocean and then you're going to put policies to fix the ocean, not fixing where it starts, the source is not being targeted (Participant 11)*

Furthermore, documentation indicated that current legislation is reactive in nature.

> *The majority of these [environmental and disaster related] laws is a reactive approach that lays emphasis on traditional 'response and relief', rather than developing an institutional framework that supports a coordinated response involving prevention, preparedness and contingency planning. There have been successive amendments to these laws, but they remain sectoral in scope, and mostly reliant on traditional command and control measures. (NaDMA, 2014, p. 38)*

The draft EMA would fill an important gap in the current legislative framework, which does not mandate a proactive or precautionary approach to environmental protection and waste management.

### 5.3.2 Land use

As a small island state with mountainous topography, land use and space are key environmental pressure for Grenada. Identifying lands for waste management activities has been an ongoing issue for several decades. Land availability is highlighted as a constraint in the National Sustainable Development Plan:

> *Grenada's solid waste management system includes a disposal facility, but it is almost at its capacity and land availability challenges constrain its expansion. Therefore, these challenges necessitate the development of environmentally sound (both solid and liquid waste) disposal infrastructure that includes waste-to-energy and recycling facilities (National Plan Secretariat, 2019, p. 89)*

Two GSWMA employees indicated that it has been an ongoing struggle to find locations to build sanitary landfills, and documentation indicated that it has been the government's intention to find an alternative location for decades (Government of Grenada, 1995b; Rosenberg and Korsmo, 2001).

> *When I first joined the Authority, one of the first things that we did was to look around [for a location for a landfill]. A number of sites were identified, but I am not sure how much work was done into physically marking out an area, saying this is a location for a landfill. And so when we visited those sites, we saw development was taking place, houses going up. Sites that we once thought were potential [landfill] sites, now you can't go and put a dumpsite here because we [have] houses here. So finding a suitable site is not easy and its going to get harder and harder (Participant 1)*

One document indicated that "land ownership problems" were preventing the Ministry of Health from finding a suitable replacement location for the Perseverance dumpsite (USAID, 1984). Grenada's lands are predominantly privately owned (Participant 24); documents confirmed that only 10% of land in Grenada is state-owned (Government of Grenada, n.d.; Jeco Caribbean, 2011). Therefore, it is difficult for statutory bodies like the GSWMA to acquire the land. This struggle is further exacerbated by lack of a land use policy, and a development plan that formally earmarks land for infrastructure development.

Traditionally, waste has been dumped in swamps, wetlands, and coastal areas (The Caribbean Conservation Association, 1991). The Perseverance estate was initially selected as a dumping area in the 1960s due to its isolation (Participant 1 and 3) as a "swamp adjacent to Halifax Bay" (USAID, 1984, p. 17). However, it is not an ideal siting location for a landfill or dumpsite, given its coastal proximity and adjacency to a conservation area for the Grenadian dove.

> *If you were to look at the geology of this place [Perseverance] you might conclude that this is probably one of the* ***worst places to put a landfill****….you have steep cliff on one side, then you have a set of colluvial soils, so you have potential for a lot of landslides, there is a lot of water coming down in those areas. (Participant 1)*

The state of the current dumpsite and citizens perceptions of a sanitary landfill played a role in the level of comfort residents experience with a landfill in their communities.

> *In every community that [we] went, the persons were against it. So there was a lot of resistance in moving to landfilling in another area because persons were aware ofwhat was happening in Perseverance and they thought that was going to happen in their area also. This resulted in protest against landfill being brought to their area. (Participant 3)*

By the nature of being an island state, accessing and allocating land to waste management activities has been a long-term issue – this issue has only intensified due to economic growth and tourism development. One participant indicated that the government has a long-standing focus on building a strong economy with foreign investment in hotels and marinas as a means of solving economic challenges (Participant 24). In this respect, environmental considerations and planning in development remain an afterthought. As stated previously, Grenada does not have a promulgated Land Use Plan, therefore coastal and urban development is unplanned. Lack of policy and enforcement of planning legislation has led to loss of important natural, historical, and cultural

resources (The Caribbean Conservation Association, 1991). One participant indicated that environmental planning mechanisms are often perceived as obstacles to development.

> *Anything we do as development, not development as in **appropriate development**, but economic investment…. anything that gets in the way of that, so if you suggest an EIA or you say 'this is a heritage resource', they are considered **obstacles to development**. Why are you slowing us down? Why are you distracting us? Focus on developments that will bring jobs. (Participant 24).*

The focus on development and jobs has resulted in limited environmental protections, with government viewing development objectives and environmental protections as being in conflict. In the early 1990s, the government reportedly "appear[ed] reluctant to translate even the more obvious environmental warning signs into regulatory or incentive based environmental policies." (The Caribbean Conservation Association, 1991, p. 245). The recent formation of the Grenada Land Actors and their call upon the government "to act in the interest of our communities and protect our shared natural and cultural heritage" indicates that environmental protections are currently not being taken seriously by the government (https://grenadaland.org/). The group cites three environmental sensitive areas of immediate concern (Mt. Hartman, Levera and La Sagesse) that are undergoing clearing and development in absence of meaningful and transparent environmental impact assessment and establishment of monitoring frameworks. These works may contravene the Physical Planning Act of 2016 and run counter to the "Blue Growth Coastal Master Plan" principles of sustainability, precautionary principle, good governance, and equity (BirdsCaribbean, 2020; Government of Grenada, 2016a, 2016b).

Consequently, the drive for development and modernisation, without land use planning, has placed the waste management authority in an untenable situation in which the landfill constructed in 2021 is only planned to last a few years, and there are no remaining locales to continue to deposit waste.

### 5.3.3 Gaps in existing legislations

Grenada has several Acts that impact waste management in the island state (Table 3.14). Legislative effectiveness, however, is weakened from lacking necessary regulation and policy for implementation of the legislation, penalties and levies being inadequately applied and enforced, and mechanisms being outdated and not reflective of the current material flows (Chapter 4). There is lack of clarity around the roles and responsibilities of the GSWMA and Ministry of Health when it comes to developing policy, regulations, and enforcement of waste management legislation (PAHO,

2004). For example, as noted in the waste management strategy (Government of Grenada, 2003), the Grenada Solid Waste Management Authority Act (Government of Grenada, 1995a) gives the GSWMA broad authority to implement waste management activities, while the Waste Management Act (Government of Grenada, 2001) assigns roles and responsibilities to various agencies, most notably the Ministry of Health.

This section outlines specific findings that illustrate challenges with legislation. Furthermore, it addresses National Goal #7, which is "*update existing legislation and/or create and enforce new legislation to support Environmental Protection and sustainability"* and "*Enforce litter act and increase fines for illegal dumping"* (National Plan Secretariat, 2019, p. XXXIV).

#### 5.3.3.1 Pollution control

Pollution makes Grenada's social-ecological system vulnerable and decreases the resiliency of the island (Participant 9). As open dumpsites, Perseverance and Dumfries lack basic pollution control measures, like leachate management, gas management, and covering that prevents leakage of materials. Therefore, the amount of solids waste being generated, deposited in dumpsites and the environment (i.e., DPO; see Chapter 4), and pollution resulting from the decomposition (i.e., leachate) and burning of waste represent significant environmental and human health pressures. There have been long-term concerns about open dumping in Grenada; documentation describing concerns about the Perseverance and now-closed Grenville dumpsite are reflective of current pressures observed at dumpsites during field work. For example, in 1984, the Grenville dump site was at capacity, and therefore "waste is dumped directly on the beach" resulting in "…uncovered garbage scattered about the Northeastern beaches" (USAID, 1984, p. 17). To address pollution concerns at the time, the Infrastructure Revitalization project indicated the following mediation measures:

> … *construction of earth berms at Perseverance and Telescope land-fills to reduce leaching, the placement of a portable wire fabric fence at the proposed Telescope land-fill to prevent fugitive trash from offshore winds, and the daily covering of Perseverance and Telescope land-fills with a proper layer of soil (USAID, 1984, p. 5)*

Leachate and pollution from the Perseverance dumpsite was a concern almost 30 years ago, and remains a concern (Government of Grenada, n.d.):

> *Because of the erratic manner in which the Perseverance landfill has been managed, concern has been raised about the possibility of toxic or high-BOD leachates contaminating the surface water or groundwater resources or Halifax Harbor itself. Waste oil from St. George's, from government vehicle operations, and from electric generation facilities is dumped at the landfill and has severely contaminated the adjacent swamp (The Caribbean Conservation Association, 1991, p. 190).*

During a visit to the Perseverance former cell, I observed leachate from the collapsed, non-functioning landfill flowing downhill, directly towards the watercourse (Participant 7).

The current state of the dumpsite has been described as 'chaotic' (Participant 3), with fires being an ongoing issue at the Perseverance dumpsite (Participant 2, 11, 26). One participant remembered that motorists could not see the road as they drove past the dumpsite (Participant 11). At the time of writing (January 2021), the dumpsite had been on fire since March 2020 (GSWMA, 2020c). Furthermore, a fire in 2017 lasted between 1.5-2 years, and social media accounts indicated that two fires in June 2021 (one at the dumpsite, and one at another debris and tyre pile) had been started and not yet contained. Additionally, during the field visit, the researcher observed a tyre fire at Perseverance that lasted for several days, and a fire in the main dumpsite that was narrowly contained. Burning at Perseverance is an ongoing environmental and human health issue (NaDMA, 2014), but to the researcher's knowledge, there has not been any data collected to assess the environmental or human health impacts on the surrounding ecosystem or human settlements; notably, in the March 2020 fire, the GSWMA did plan a community meeting in the surrounding communities to listen to residents' concerns (GSWMA, 2020c).

Currently, there are no pieces of legislation or regulations in Grenada that control the quantities or types of pollution being emitted into the environment (i.e., air, water, or soil) (WSP Caribbean Limited, 2018c). While the GSWMA has documented qualitatively and demonstrated awareness of pollution (GSWMA, 2017, 2016, 2015, 2014), there is no institutionalized monitoring from the GSWMA, the Ministry of Health or Ministry responsible for the Environment. There is also an absence of regulation that stipulates ongoing quantification of environmental pressures, such as inflows of pollutants into the marine environment, water courses, soil, and air surrounding the Perseverance and Dumfries dumpsites. The GSWMA Procedure Manual indicates guidance for monitoring of surface and ground water, leachate, landfill gas, potable water, and landfill subsidence (T.P. Smith Engineering Inc, 2003). Furthermore, the manual also indicates that the GSWMA should also conduct quality assurance, quality control and create landfill monitoring reports (T.P.

Smith Engineering Inc, 2003). To my knowledge, data is not being collected. I was able to find only one study that measured nutrient loading from the Perseverance dumpsite. Nimrod et al. (2013) collected water samples in the Salle River, which runs directly through the Perseverance Dumpsite. The results of the study indicated that the Salle River at Halifax Harbour had high nutrient concentrations (ammonia, phosphates) compared to the other two rivers sampled in the study (Beausejour and Dragon Bay) (Nimrod et al., 2013).

### 5.3.4 Penalties and levies

Grenada's legislation outlines fines for improper waste disposal under at least two different Acts, the Waste Management Act and the Litter Abatement Act (and its predecessor) (Table 5.1). The legislation is not clear, however, what current legislation takes precedence, and therefore how fines are applied for people caught littering and dumping waste outside of the two dumpsites.

The Waste Management Act states that persons that generate waste and who discard it contrary to acceptable means are subject to a penalty of $20,000 or imprisonment for three months (Government of Grenada, 2001, sec. 32(3)). Furthermore, depositing waste in a National Park or protected area, or in a manner likely to cause pollution to environment or harm human health (Government of Grenada, 2001, sec. 33) is an offence, and incurs a penalty of $50,000 and imprisonment for six months. It was not clear how the Waste Management Act was applied, with respect to the former Abatement of Litter Act (Government of Grenada, 1973) up until it was repealed in 2015.

The Abatement of Litter Act of 2015 was commenced in 2019 (Government of Grenada, 2019). Under this Act, a fixed penalty of $100 for a person (Sec.3 (3a)) or $500 for a corporation is applied. Summary convictions are $300-1500 or six months for a person, or $1000-$4500 for a corporation (Section 3(3)). The Act outlines fines and enforcement mechanisms to deter littering; fines can be issued by police, litter wardens, forestry officers and environmental health officers.

| Legislation | Penalties for littering or illegally discarding waste |
|---|---|
| Abatement of Litter Act, 1973 (Repealed) | Fine of $1500 and imprisonment of 6 months. |
| Waste Management Act, 2001 | Fine of $20,000 and imprisonment for three months. |
| Abatement of Litter Act, 2015 | Fixed penalty of $100 for person<br>Fixed penalty of $500 for body corporate |

Table 5.1 Penalties for littering or illegally discarding waste

Given the onerous fines for littering under the Waste Management Act (Government of Grenada, 2003), it is not surprising that convictions were not widely applied to people dumping or littering. The Litter Abatement Act was enacted in 2015 but was only recently commenced in 2019. To the researcher's knowledge, this Act is not being enforced. During field work, there was significant press coverage as well as experts commenting on the lack of enforcement of the legislation (Participant 3, 8, 13, 22, 25). Participants from the GSWMA expressed challenges with lack of enforcement of the Litter Abatement Act, and the practice of illegal dumping (Participant 3, 8, 14; Focus Group 1). While they regularly work together, at times, the GSWMA felt that the Ministry of Health or the Police did not take their enforcement role seriously. Without enforcement, one participant indicated that waste management was a joke (Participant 3).

> *The Ministry of Health erects signs of 'No Dumping' [as] directed by Ministry of Health.* ***And you see [people] dumping on the sign itself****. [The GSWMA] calls the Ministry Health and [ask] 'can you put some surveillance out and charge persons for illegal dumping?' and they said, 'so you all want us to lock up people for [dumping]?' (Participant 3)*

From the Ministry of Health's perspective, however, the current legislation and legal system in Grenada makes littering and dumping legislation difficult to enforce. Participants indicated that the Environmental Health department lacks monitoring and enforcement capacity. They would like to use cameras to deter dumping in hotspots, like Windsor (Participants 13) as enforcement is required by an on-duty officer (Participant 17). Enforcement also requires community participation, as dumping often occurs in secluded areas in the night (Participant 17) and *everybody knows everybody* on a small island state, so people do not talk (Participant 14). One participant indicated the importance of issuing a ticket immediately, something that is possible under the Litter Abatement Act:

> *The legislation [needs to have] a little more teeth in terms of when you observe person's doing illegal things within the community, we must be able to quickly address it. Because if someone do illegal*

> *dumping, what we could do? Call him and ask him to clean it up? We could take them to court but the process from identifying and get the person to answer the charge in front of magistrate or a judge, it is too long and drawn-out. That needs to be more speedy. We need to devise a mechanism so polluters pays. Issue some kind of immediate document, like how the Police issue tickets. And once you have one or two person this can happen and have one or two person being indicted and you can publish at any newspaper or some kind of message would get around. It would definitely get around. (Participant 26).*

Another participant highlighted the difficulty of enforcing the Litter Abatement Act with respect to derelict vehicles due to lack of clarity around responsible parties for enforcement (Participant 22). The Police and the Ministry of Health, Environmental Health Department are both in charge of enforcing the Act. Furthermore, the Ministry of Health lacks the capacity to enforce, that is, to actually remove the vehicle from the roadside.

Littering and dumping may also be encouraged by the government not appearing to follow its own rules. Two examples were provided by one participant (Participant 17): the government authorizing debris dumping in Telescope during emergencies, and the Ministry of Works not ensuring that debushing campaigns take the waste to Perseverance.

Consequently, Grenada does not have the resources dedicated to monitor and enforcing existing laws related to littering and dumping penalties (Participant 13, 17). Several documents suggested that enforcement of waste management legislation, and environmental legislation in general was a challenge in the small island. For example, the National Strategic Development Plan (Government of Grenada, 2007b) suggested that there should be an annual increase in fines and number of enforcement officers for improved enforcement of environmental legislation. The National Waste Management Strategy suggests the creation of a Waste Management Officer position to ameliorate capacity limitations and coordinate implementation and compliance with the duties under the Waste Management Act (Government of Grenada, 2003) (Focus Group 1). To my knowledge, neither of these measures have been put in place.

The government of Grenada was lauded for its achievements in cost recovery for waste management activities, as legislated by the Environmental Levy (EVL) Act, in the early days of the GSWMA (PAHO, 2004; The World Bank, 2003a). There is, however, evidence of an unfair distribution of cost amongst waste generators (PAHO, 2004). The polluter pays principle is an established principle in environmental management and held as a key principle in the draft

Environmental Management Act (Government of Grenada, 2005) as well as the National Waste Management Strategy (Government of Grenada, 2003). Current implementation of this principle in Grenada falls on the shoulders of the Environmental Levy Act, which charges set fees for importation of certain (limited) products and rendering of waste management services by the GSWMA. The Environmental Levy Act has been amended selectively since enactment; however, it continues to be both inadequately applied and enforced, and outdated. Except for amendments related to beverage bottles (Table 5.2) and the addition of tyres, environmental levies charged for products and services have not been updated since enactment in 1995. Therefore, the cost of 'polluting' has remained - at best - stagnant for 25 years.

Households are charged a set fee for waste management services of $5 or $10 a month, tiered based on their electricity consumption. The charge is included on the occupants' electricity bill, administered by GRENLEC. A conversation with a GRENLEC employee confirmed that commercial entities, such as apartment buildings, stores in urban areas, and hotels, do not pay the environmental levy charged on households' electricity bills. Therefore, commercial entities are *supposed* to be paying for waste management services through other channels. Under the Waste Management Act, ICI waste generators "must make arrangements for management of the waste and must ensure that any waste generated does not present a risk to human health, safety or the environment" (Government of Grenada, 2001, sec. 38). Generators can arrange to have their waste transported by a licensed hauler, processed and managed on site, or transported to the dumpsites themselves[21]. However, many ICI clients use public bins and household waste contractors to collect ICI waste, and therefore 'piggyback' on the public system (Participant 3, 14).

Data used in the MFA (Chapter 4) and observations indicate that a number of larger businesses, such as hotels, do make arrangements to transport waste to the dumpsites. Other commercial entities, such as tourist and student apartment buildings, do not pay an environmental levy, and therefore contractors collecting waste do not receive additional services fees for accommodating the additional waste burden and collection routes (WSP Caribbean Limited, 2018d, 2018b). One participant indicated that commercial development, including development of apartments to accommodate growth in the tourism sector and the student populations (St. George's University) has *stretched* the GSWMA's capacity (Participant 3) to provide adequate collection services. Yacht-

[21] Under the Waste Management Act, arrangements include contracting a licensed hauler, transporting waste to a licensed facility, or building a waste processing facility (with approval).

based tourists are also not required to pay for waste disposals, and often come ashore and drop household waste in public bins (WSP Caribbean Limited, 2018d, 2018b).

Observations and conversations with business owners indicated that several restaurants and hotels use public bins for waste disposal, instead of abiding by the Waste Management Act. Participants from the tourism and restaurant sectors demonstrated limited knowledge of the commercial sector's responsibility to transport their operation's waste directly to the dumpsites. On several occasions, participants expressed dissatisfaction with the GSWMA's level of service to the public bins supporting their businesses (Participant 15 & 25), without acknowledging or understanding that their business received this public service free of charge.

Furthermore, ICI clients do not pay a tipping fee at Perseverance. Under the Environmental Levy (EVL) Act (Third Schedule), the GSWMA is permitted to charge a $75/ton (or $68 per tonne) tipping fee at Perseverance. This fee, however, has never been applied for fear of increased illegal dumping or 'fly-tipping' (Participant 3 & 5) (Government of Grenada, 2003).

> *The fee was never introduced because it was felt that private waste haulers and other trucks carrying waste would not come to the landfill to dispose of the waste, it was never officially introduced. We don't [have] a tipping fee at the landfill at the moment, and some of the commercial sector bring[s] their stuff to the landfill while others don't, they use the bins. …They're not adhering to the fact that we're asking them not to dispose of waste [in and around] the communial bins (Participant 3).*

Therefore, while commercial entities are supposed to bear the cost of their waste, in both transportation and disposal, they currently do not pay any fees for collection or disposal services rendered by the GSWMA. Lack of enforcement of both the Waste Management Act and EVL Act is problematic as generators are not motivated to decrease their waste generation, and not paying their fair share for the services. Both the National Waste Management Strategy (Government of Grenada, 2003) and consultancy updating the strategy suggested implementing a varied tipping fee that would allow commercial entities to pay less for green waste or segregated waste compared to mixed, co-mingled waste (Government of Grenada, 2003; WSP Caribbean Limited, 2018c). Another participant suggested that commercial entities could also be charged on their electricity bill and have curbside collection (Participant 13). During the focus group with the GSWMA, there was a tension between employees on the 'right' way to charge commercial employees. Some felt that a "tipping fee

is universal" to promote diversion, while others felt that commercial entities should be charged a levy, like households (Focus Group A). Regardless, there seems to be agreement that commercial entities need to be paying their fair share for waste.

Currently, the EVL Act does not capture most plastic packaging, except for beverage bottles (Chapter 4). The EVL Act (and the products applied) was likely established based on the widely consumed products at the time (Participant 21), but the results of Chapter 4 indicate that the EVL Act is not reflective of current consumption patterns. Under the EVL Act, the levy is applied based on the Harmonized System (HS) code on the commodity. The HS Code reflects what the commodity is (e.g., pasta), and does not reflect the packaging that the commodity arrives to Grenada in. Therefore, packaging types and amounts are difficult to isolate in trade data (Participant 21).

Analysis of legislation impacting deposits or levies charged to beverage bottles indicates that the breath and expense of levies and deposits has decreased over time. Plastic and glass bottles are charged the same $0.25 per bottle legislated in 1995; this charge is for specific HS codes *imported* into Granada. The repealed Trade (Non-Returnable Container) Levy Act of 1993 imposed a deposit on either the importer *or* producer of non-returnable containers (Government of Grenada, 1993). This would address a current gap in the EVL Act, which only applies to specific commodity codes upon importation – consequently, products like preforms that blow into bottles are not charged an EVL, despite having equivalent waste potential of bottles (GSWMA, 2020a) (Chapter 4).

| Act | Amendments, SRO | Impact of the legislation |
|---|---|---|
| Act No. 32 of 1993 - Trade (Non-Returnable Container) Levy Act (Repealed) | Principle Act | **Definition of container:** "non-returnable container" means a container of a deposit product made of glass, metal or plastic which is not to be returned to the supplier or producer. "Deposit product" means beer, stout, malt beverages and aerated drinks which are for sale in non-returnable containers<br>**Deposit levy:** $0.25 per glass or plastic, $0.50 metal<br>**Point of charge:** Where the deposit product is imported, the deposit levy becomes due and payable by the importer at the point of entry. Where the deposit product is produced locally the deposit levy becomes due and payable by the producer at the place of production at the time of sale.<br>**Refund:** deposit levy shall be refunded to the depositor on re-export of the non-returnable container or if disposal arrangements are made and executed by the depositor in a manner acceptable but to the competent authority within six months from the time of payment of deposit. After six months, deposit forfeited and paid to the consolidated fund.<br>**Responsible party:** Comptroller of Customs and Excise |
| | SRO 20 of 1996 - Trade (Non-Returnable Container) Levy Order (Repealed | **Deposit levy:** Increased deposit levy on importation of more than 30 cases of beer, stout, malt beverage or aerated drinks to $0.50 per non-returnable container. |
| Act No. 29 of 1996 - Environmental Levy Act | Principle Act (Repealed) | **Definition:** "Non-returnable container" means a container made of glass, metal or plastic which is not returned to the supplier or producer.<br>**Levy:** $0.25 per container<br>Point of charge: Importer<br>**Refund:** No refund.<br>**Responsible party:** proceeds of a levy are paid over to the GSWMA within 10 working days after such collection from the Comptroller of Customs |
| Act No. 5 of 1997 - Environmental Levy Act | Principle Act | **Definition of container:** "Beverage container" means the container designed to be used for the storage of the beverages and other products specified in the First Schedule. First Schedule lists applicable products from HS 21.01, 22.02, 22.03, 22.08, 21.06<br>**Levy:** $0.25 per container<br>Point of charge: Importer |

| | | |
|---|---|---|
| | | **Refund:** refunded on satisfactory proof to the Comptroller of Customs of the re-export thereof or if disposal arrangements are made and executed by the importer in a manner that is acceptable to the authority within six months from the time of payment of the levy.<br>**Responsible parties:** the proceeds of a levy collection under Section 3 shall be paid over to the authority within 30 days of each collection or within such. As the Minister permits in writing. |
| | Act No. 12 of 2000 - Environmental Levy (Amendment) | **Refund:** 75% of the levy paid with respect to beverage containers shall be refunded within six months of payment on satisfactory proof to the Comptroller of Customs by the importer of re-export or the disposal in a manner that is acceptable by the Authority.<br>**Levy:** $0.50 per container |
| | Act No. 13 of 2007 - Environmental Levy (Amendment) | **Definition of container:** "Beverage containers" means any container designed, used, or produced for the storage of beverages and other products as listed in the First Schedule". First Schedule added HS 20.09 (Fruit Juices)<br>**Levy:** $0.25 per container<br>**Refund:** Increased from 75% to 80%. Additionally, one hundred percent of the levy paid with respects to a beverage container which is imported into Grenada for manufacturing purposes and is not sold within Grenada shall be refunded within six months of such payment by the comp troller of customs on satisfactory proof by the importer of its re-exportation |

Table 5.2 Charges for beverage bottles under Grenadian legislation over time

One recycler indicated that recycling entrepreneurship was limited based on the current application of the EVL Act (Participant 12). Under the act, importers of beverage bottles can receive an 80% refund on the EVL if they demonstrate that the product had been properly disposed of, either exported or deposited at the dumpsite. The refund can only be given to the original importer within 6 months of importation; this forms an unnecessary barrier to entrepreneurship, as exporters would not receive a benefit of managing the waste (Participant 12). Based on my conversations with employees at the GSWMA, there seemed to be tensions around how the EVL should be refunded, and if 'proper disposal' constituted disposal at the dumpsite (Focus Group 1). One employee felt strongly that refunding the EVL for bottles brought to the dumpsite was not right because the GSWMA became responsible for managing this problematic waste source, with only 20% of the EVL. Another employee reflected that it encouraged disposal at the only approved site on the island (Focus Group 1). Regardless, the EVL is not widely refunded (Participant 3), likely due to the restrictive barriers in the legislation.

Another participant indicated that manufacturers of beverages, including distilleries, may not be widely open to bottle deposit-return system because there are limited options to deal with the returned bottles.

> *Honestly, I doubt there would be much openness for it. But it is actually a good idea, something to consider. The only thing is if it's return, what do we then do with it? Send it to Perseverance again? (Participant 20).*

Recent levies added to tyre imports are not used to fund waste management activities. Instead of levies being allocated to the GSWMA, the tyre levies are specifically not transferred to the GSWMA, and therefore become government income (Government of Grenada, 2015a). Two participants offered the same speculative explanation for this amendment: the government was experiencing a deficit and structural adjustment at the time and needed additional funding at the time (Focus Group A, Participant 22). Consequently, the EVL is used as an income line for the government, rather than a deterrent for generation and growth in tyre waste and facilitating improve waste management practices. This is particularly problematic due to the lack of communication to tyre shop owners on *what* the fee was being applied to. Conversations with tyre shop owners and operators indicated that they were frustrated with paying the fees, but not seeing the benefits of enhanced waste management of their waste (Field Notes, January 24, 2019).

The current transfer of levies to the GSWMA limits their ability to adequately address the diversity of materials. Under the EVL Act, levies collected from tourists and imported goods are collected via the Government Consolidated Fund. Evidence of an accounts receivable indebted to the GSWMA indicates that transfers from the government are slow and subject to government priorities (GSWMA, 2017, 2016, 2015, 2014; PAHO, 2004) While the EVL Act indicates that this transfer should happen within 30 days, longer time periods are permitted by the Minister in writing (Government of Grenada, 1997). One participant indicated that this has created an issue with both getting *enough* financing in a *timely* manner, as the government using funds earmarked for Statutory bodies to manage debt (Participant 5). It also limits what the GSWMA can achieve with improving waste management. For example, the National Waste Management Strategy states that "imported products may serve as a basis for financing broader activities that address waste management objectives to reduce litter and build opportunities for recycling" but emphasized that actions can only be realized if levies are promptly remitted to the GSWMA (Government of Grenada, 2003, p. 26). The EVL Act has potential to influence the volume and nature of waste (Government of Grenada, 2003), but observations suggest that it is not yet been utilized to its full legislative potential.

### 5.3.5 Banning and restricting trade

The Non-Biodegradable Waste Control Act was passed in 2018, and was in the process of being implemented during my field work (Section 4.3). One means of controlling the importation quality of goods is through the use of standards for products (Participant 22, 23). One participant in government suggested that while cheap goods may be economical for importers the "the cheapest may not be best for the country" (Participant 22), further suggesting that both trade and the Bureau of Standards need to work together to ensure long lasting, quality products.

### 5.3.6 Regulations, policies & management plans

To date, legislation impacting waste management has not been updated and implemented with applicable regulation. Table 5.3 provides an overview of the regulations permitted under various waste management legislation. Furthermore, necessary policies and management plans have not been developed to support legislation.

The Waste Management Act was enacted to address the restrictive focus of the (repealed) Abatement of Litter Act (Government of Grenada, 1973).

> *A major deficiency of … the Abatement of Litter Act, is its restrictive focus, namely, the collection and disposal of waste. It does not address waste management as a process involving a wide range of related activities such as waste production, collection, transportation, separation, recycling, reuse and disposal. Also, no regulations have been established to implement such principal legislation in order to provide guidance for environmental managers (Government of Grenada, 1995b, p. 20).*

The Waste Management Act is quite comprehensive, especially when paired with the Waste Management Strategy (Government of Grenada, 2003, 2001). Unfortunately, the challenge identified remains identical to the problems with the 1973 Abatement of Litter Act: regulation and management plans required to implement and enforce the Waste Management Act have *yet* to be developed (Participant 26) (GSWMA, 2020d). The absence of regulations supporting implementation of the Act was identified as a major weakness in waste management legislation (PAHO, 2004). Regulations that can be made by the Ministers are listed in Box 5.1; the National Waste Management Strategy further prioritized regulation development as a key aspect of the 5-year implementation plan, beginning in 2003. While these regulations include key elements of sound waste management, like reduction, regulating and restricting importation of inferior goods, and waste diversion, I did not find any evidence of regulation development in this research.

In reviewing legislation for the ISWM project, the consultants suggested that a review and update of the Waste Management Act could include reinforce application of the polluter pays principle and the waste hierarchy framework (WSP Caribbean Limited, 2018c). The consultants recommended a list of legislation, policies, regulation, and management plans that align with existing legislation like the Waste Management Act, the drafted Environmental Management Act, and the National Waste Management Strategy. While some participants indicated that the GSWMA was operating without strategy and was waiting on recommendations from the consultants updating the strategy (Participant 1,3; Focus Group 1). This dissertation recognizes the importance of updating both the Waste Management Act and the National Waste Management Strategy. With that said, it is important to recognize that the GSWMA and government of Grenada *already have the guidelines and information in place* – the problem is that the strategy has not yet to be implemented (Participant 26).

> *We always have a lot of plans and a lot of paperwork, but our problem is implementation period finance could be part of implementation and legal requirements. Those are the two... barriers to implementation period and then human resources. We need to start now. If you don't start, the mindset and culture of the people will not change. (Participant 26)*

| Act | Responsible party | Section and regulations allowed |
|---|---|---|
| Waste Management Act | Minister responsible for finance | Section 45: Establishment of fiscal incentives and inducements required to implement the strategy and other provisions of this Act. |
| | Minister responsible for health | Section 46: Regulations for the purpose of implementing provisions in the Act (see Box 5.1 for complete list) |
| Grenada Solid Waste Management Act | GSWMA, with approval of the Minister responsible for the environment, subject to affirmative resolution by the House of Representatives | Section 15. Regulations for a) measures and methods to be adopted for improved waste management b) imposition of fees or charges |
| Environmental Levy Act | Minister22 | Section 11A: Regulations for giving effect to the provisions of the Act |
| Litter Abatement Act | Minister responsible for the environment | Section 15: Regulations for the purposes of carrying into effect any provision of this Act. |

Table 5.3 Regulations permitted under waste management legislation

Therefore, it is an implementation gap, not lack of identified actions, that is holding back progress in providing management plans for hazardous waste management and waste reduction.

This implementation gap is further evident in the National Strategic Development Plan (Government of Grenada, 2007b) which suggested that the management of solid waste, include e-waste and ship-generated waste should be strengthened, and that an effective recycling programme should be designed and implemented between 2007-2017.

[22] The Act is not clear who the Minister is, with the exception of Section 8 which indicates the Minister of Finance may amend any of the three schedules in the updated Act.

a) respecting the development and updating of the Strategy;
b) implementing any waste diversion and waste reduction policy contained in the Strategy;
c) respecting waste management strategies and operations generally;
d) respecting the conduct of environmental impact assessments for waste management facilities;
e) as to the contents of environmental protection plans and waste management plans;
f) regulating applications for licences and permits;
g) respecting enforcement mechanisms for prohibitions against littering and discarding of waste;
h) establishing standards and requirements for waste handling, separation and processing;
i) regulating or restricting for the purposes of this Act the import of used second-hand, refurbished or reconditioned materials or goods;
j) prescribing fees for the processing of applications, for the issue of licences and permits, for inspections and for other services related to waste management;
k) with regard to the training of people for the purposes of this Act;
l) promoting public education in waste management and the production of secondary resources.

Box 5.1 Regulations permitted under the Waste Management Act.

There have been a few entrepreneurial responses to Grenada waste problems that address reuse and recycling of resources, but unfortunately it seems that none of these responses have been sustained over time due to lack of institutional support from the government (Participant 2 and 12). GSWMA employees indicated that there is a desire to develop entrepreneurship in Grenada, to alleviate the pressure of waste accumulation.

> *I am one that don't feel that one should stretch themselves to the bursting stage, where you where you basically become irrelevant. I hope that out of all the studies and the directions for waste management, they could come up.... we would see coming out of this,* ***entrepreneurs trying to get involved ...not the Authority itself, trying to get into everything***

Other participants, however, indicated that there was a need for *structure,* that is a facility in place to motivate companies to separate their waste. Individual efforts of businesses and households can only go so far, and two participants expressed a desire for national support to implement and enforce improved waste management (Participant 25).

> *I think if there was a facility on the island that would accept waste and recycle it or find a better use than just putting the it in the landfill that would help because people, the companies will be more encouraged to segregate waste and send it there for recycling. (Participant 20).*
>
> *"I think generally on the island, most of the initiative has been by entrepreneurs themselves. Sure, we push the Pure Grenada concept, but I still think.... government need to play like a bigger role in ensuring that a lot of what they would like to see happen, that they provide the enabling institution" (Participant 25)*

Grenada, however, is lacking regulation and policies that outlines implementing standards and procedures for developing recycling and composting infrastructure. For example, Grenada has signed a Memorandum of Understanding (MOU) with Parley for Oceans with the goals of intercepting and shipping plastics off the island for recycling (Parley for the Oceans and Government of Grenada, 2016). To date, none of the goals of the MOU or subsequent planning documentation have been realized. One participant indicated that, while the MOU with Parley was still valid and actionable, Grenada currently lacked the capacity and legislative framework to implement the required actions to isolate, bale and ship the plastic off the island (Participant 18). Furthermore, *diversion* as part of a broader waste management strategy and the Integrated Solid Waste Management Project, is required before Grenada is ready to ship plastic off the island (Participant 18). Another participant indicated that Parley 'up and left' when they were quoted the costs from the GSWMA (Focus Group A). Consequently, there is a need for an established legislative framework to support diversion activities in the private sector. This would allow the government and GSWMA to be prepared, should opportunities for partnership arise.

Grenada lacks management plans, regulation and legislation that effectively support the management of hazardous and problematic waste. Communication from the government indicated that Grenada had a 'National Hazard Waste Policy' and 'National Oil Pollution Control System' (Government of Grenada, 2009), however I was unable to source these documents. The Waste Management Act (Government of Grenada, 2001) establishes that a waste management strategy must "identify methods by which hazardous waste, quarantine waste, biomedical waste, ship generated waste and other specified classes are waste are to be managed" (Government of Grenada, 2001, sec. 5(3)). Furthermore, the same legislation makes specific provisions that the Ministry of Health must prepare and establish a used oil management system that "provides for the environmentally secure management of used oil generated in Grenada" (Government of Grenada, 2001, sec. 40(1)). The

strategy further suggests that the GSWMA, on behalf of the Ministry of Health, could take the lead in developing a used oil management system. To date, there is no management plan or system in place to deal with used motor oil. While participants indicated a usefulness of used motor oil for potential recycling opportunities (Participant 2, 12) (Section 4.5), these opportunities were not being implemented at scale. Used motor oil is also not included on the EVL Act.

Biomedical and pharmaceutical wastes are not being adequately managed in Grenada, and a number of participants expressed concern with the management of hazardous, medical and chemical waste (Participant 18, 22). Ministry of Health employees indicated that the Ministry of Health has a protocol for biomedical waste: it is transported to the General Hospital in St. Georges and incinerated (Participant 13). The incinerator at the hospital, however, is ineffective at rendering the waste harmless and is often broken down (Participant 13, 18. 19). There have been a number of audits on biomedical waste management practices (E & ER Group, 2002; Forde, 2007, 2005), and despite being dated, one participant indicated "I'm not certain if anything has changed from then." (Participant 19).

Furthermore, Grenada does not have a policy on dealing with pharmaceutical waste. One participant indicated that a committee, under the guidance of the Environmental Health Department, had formed to discuss and develop a policy on biomedical and pharmaceutical waste. The committee had not been active for at least 5-years at the time of the interview (Participant 19).

One participant expressed concern about the implementation of information technology without consideration for e-waste (Participant 24). Currently, Grenada lacks an institutionalised management plan for e-waste. E-waste is sent to dumpsites with other household waste (The World Bank, 2019b; WSP Caribbean Limited, 2018b), and observation confirmed the accumulation of e-waste at both dumpsites and illegal dumping spots around the country. During an interview, I described to an interviewee how e-waste is processed by informal workers at Perseverance "…people drop off TVs or TVs come in with regular waste. [The TV] gets smashed through the front, so they [informal workers] can take out pieces of copper, and then [the wire] is burned to get the copper out of it and the rest, glass everything just stays there."

> *They [the Minister, the government] will say these things, 'we're using email, we're using computers' I've heard that before as well and I am like ...* ***But you are not managing, regulating waste [e-waste]****. We are going to have a problem with that. (Participant 24)*

The drive to modernise and digitize is evident is several projects documentation and reports. The Rio+20 preparatory report calls for both "software systems…which will reduce excessive use of paper" and "better recycling and proper disposal of old computers" (Government of Grenada, 2012b, p. 25). In the *'Digital Government for Resilience'* project, e-waste is an expected environmental issue therefore a consultant will be hired to develop an e-waste management plan (EWMP) prior to the replacing old equipment (The World Bank, 2019b, 2019c). It is not clear, however, how e-waste will be processed following the conclusion of the project and if the plan will become an institutionalized practice. As it is critically important to modernise and digitize Grenada's economy, e-waste needs institutionalized regulation and policies – in addition to project plans. To date, Grenada is not signed on to any waste management or pollution management treaties, such as the Basel Convention that addresses hazardous waste including e-waste (Participant 24).

Participants from the government and GSWMA also expressed the need for further legislation and regulations to restrict importation of used vehicles and tyres (Participant 7, 18, 22).

> *Trade can look more closely at the quantity of imports that we are bringing in, and [the] impact on the environment. For example, currently, we are looking at policy to address used vehicles. We don't have any restriction [on used vehicles], you can bring in any, any age [of vehicle]. Some other jurisdictions, they said 'No, you cannot. If it is beyond a certain age, we will not [let you import it] (Participant 22)*

Similarly, Participant 5 suggested that Grenada allows the importation of vehicles that would not necessarily be accepted in other countries due to stricter emission criteria. Several interviewees equated the importation of used tyres to 'dumping' from richer countries to a poorer small island. In 2017, the majority, 88%, of used tyres imported into Grenada are exported from the United Kingdom (The Growth Lab at Harvard University, 2019).

> *I think we need to have some sort of standard on the importation of used tyres because some of the used tyres if they are coming here, most of the first world country use us as dumping grounds. (Participant 26)*

> *The government [is] allowing people to import used tyres. And you know to a lot of other countries, that is dumping because they can't handle themselves. The third world country which is vulnerable, they take it, and sometimes a lot of the tyres .... two months, they get to the third months and it comes to us [the GSWMA, the dumpsite]. (Participant 7)*

Despite concern with importation of inferior and problematic goods, like used tyres and used vehicles, legislation at the time did not set limits on importation from these types of products (Participant 18).[23]

### 5.3.7 Environmental impact assessment

There is lack of clarity around how environmental impact assessments are applied to waste management facility development. The Physical Planning and Development Control Act (2016) (Government of Grenada, 2016b, 2002) indicates under Schedule III of the Act that sanitary landfills *normally* require EIAs. Likewise, the Waste Management Act (2001) includes provisions for conducting EIAs for activities associated with waste management and processing (Part III), including pre-evaluation (Section 11 & 12), the contents of the EIA (Section 13), reviews of the EIA (Section 14), decision process (Section 15) and monitoring and evaluation (Section 16). Despite being quite comprehensive, the Waste Management Act contains one clause (Section 11(2)) which indicates that an EIA pre-evaluation (i.e., the triggering of the EIA process) does not apply *"to a facility which was in operation or under construction at the commencement of this Act."* Consequently, current rehabilitation of the collapsed landfill and building of additional cells may have been considered existing operations, and therefore the GSWMA would not have the legal obligation to inform the planning authority of waste management facility development. Consequently, despite critical importance for environmental protection, I was unable to obtain documentation from any EIAs conducted with respect to enforcing the Waste Management Act, and to my knowledge, an EIA was not conducted for the current landfill construction in 2020-2021. Furthermore, I was not able to obtain evidence about other EIAs conducted with respect to waste management facility development (e.g., for recycling businesses that are exporting waste).

## 5.4 Data collection, use and public access

The Waste Management Act stipulates that the Minister of Health is responsible for producing a national waste management inventory every 5 years; the inventory should include tonnage, proportions by classification, and estimates by sector. Based on the GSWMA Annual Reports and examination of the datasets of Perseverance and Dumfries data, waste is not robustly classified, making it difficult to determine the types of materials and the sectors of the producers. Recently the GSWMA was asked by a member of the public whether the latest non-biodegradable waste

[23] On December 31, 2020, the government of Grenada introduced a ban on the importation of vehicles 10-years and older (GIS, 2020; Ministry of Finance, 2020).

management bill had resulted in a reduction of plastics going to the landfill. The authority indicated that they were unable to answer this question because they did not have a baseline in which to assess improvements (GSWMA, 2020a). Without understanding the impact, it is difficult to motivate behaviour. Consequently, while waste accumulation at the open dumpsites is a significant pressure, data associated with this pressure is unreliable.

Environmental and human health are being adversely affected due to poor waste management practices; decades of project documentation, environmental action plans, and other related documentation indicate concern with respect to waste management threat to the state of human and environmental health (Government of Grenada, 1995b; WSP Caribbean Limited, 2018b). Both the current state and potential impacts are difficult to quantify, however, due to an absence of scientific data, measurement, and monitoring of key environmental and human health indicators. To date, there is no collated data on the accumulation of materials at Perseverance and Dumfries. As noted throughout documentation, dumpsites are a source of vulnerability and a threat to environmental health (Jeco Caribbean, 2011). Notably, now-closed dumpsites Grenville and Telescope, used to be located in a sensitive coastal area (USAID, 1984).

> *All dumpsites are located in wetlands close to the coast, where they destroy productive plant communities, displace wildlife and affect marine quality via toxic leachates with high Biological Oxygen Demand (BOD) (The Caribbean Conservation Association, 1991, p. 179).*

Without data, however, there is a lack of contextual understanding that the ongoing pressure of pollution puts on the environment. For example, at Perseverance, the GSWMA has a limited understanding of the remedial requirements and the current and anticipated pollution outflows after 60 years of open dumping. Of significant concern is the environmental health impacting the endemic and endangered Grenadian Dove population that is adjacent to the Perseverance dumpsite. Participants from the Ministry of Health indicated that mosquito fogging to prevent vector diseases at the dumpsite may have unforeseen impacts on the dove (Participants 13), but these impacts appear to be unknown. Observations indicated that solid waste, particularly large items like white goods and tyres are dumped over coasts and in ravines or wetlands (Participant 27). Inappropriate solid waste disposal was identified as a pressure that was resulting in the degradation of coastal mangroves in reports on biodiversity (Government of Grenada, 2016a).

> *Various type of solid and liquid waste and silt have been discharged into the sea eventually destroying the reefs. Most of the western coastal reefs are covered with solid waste, debris, an old vehicles. Reefs along the East Coast are also seriously affected (Government of Grenada, 1995b, p. 12)*

Several observed dumpsites were also well-known by waste management professionals and environmental NGOs, such as 'Windsor' or 'Mt. Hartman'. These areas are often equipped with a 'No Dumping' sign installed by the Ministry of Health, Environmental Health department, but without avail.

To the researcher's knowledge, there has not been any research on the state of health for waste management workers, waste pickers that work informally at the dumpsite, or the surrounding communities in Perseverance or Dumfries. Observations indicated that waste pickers working at Perseverance were subject to dangerous working conditions without proper protection, sorting through waste deposits and cutting wires for copper, while narrowly missing being run over by heavy equipment compacting and pushing the waste. Surrounding populations may be impacted from the breeding of mosquitoes in tyres and other waste that holds water, air pollution from the burning of waste, soil and water contamination, and impacts based on the poor aesthetics of the area. Participant 26 indicated that tyres do not just spontaneously catch fire, and another interviewee suggested that it might be community member to get rid the area of mosquitos (Participant 7). Participant 7 identified the impossible choice between burning tyres and allowing them to hold water.

> *From a health perspective, burning is a no-no, but I'm being honest, I think its the only way out right now. It its breeding this aedes aegypti mosquitos, its a major concern (Participant 7)*

Several participants indicated that improper waste management could lead to outbreaks in vector-borne diseases due to water holding of waste in tyres, vehicles and other products (Participant 7, 14 and 26). At the Perseverance dumpsite, tyres are collecting water and mosquitos are breeding. Participants from the Ministry of Health (Participants 13) reflected that when Environmental Health Officers encourage tyre shops to get rid of tyres to prevent mosquito breeding, they are simply transferring the mosquito problem to the Perseverance area. One participant indicated that there is an expectation from the public that the GSWMA handles waste, especially when an EVL is included.

> *... there is an environmental levy. So, the understanding of a lot of people is if a car put in a payment [of] environmental levy, Solid Waste is supposed to take these old things away. They are not taking away, they are just watching. (Participant 9)*

Litter also has the potential to block drains, leading to flooding of communities.

> *We had a big flooding in summer. So, it rained for a day, and if the drainage is not cleared up, because they were* ***blocked by waste*** *especially River Road, Woodlands, and Grand Anse and some other areas, they* ***easily flood very, very quickly.*** *And then the water just stays there. And that is due to a lot of litter, and also the clearing of bushes and stuff like that, because they're not properly cleaned. People* ***standing at the stadium, and looking down, and a car was flowing away.*** *In Woodlands, a whole house got flooded. (Participant 9)*

Without a strong understanding of the current state of the environment and human health, it is difficult to articulate the impact of existing policies and motivate further responses. Participant 4 highlighted a key concern with the public not having an idea of the state of the environment and the impacts to human health:

> *The general populace not seeing the big picture. They have probably never been to the landfill and to just think about what is going to happen with all these waste building up over time? Where was going to go? How do we store it? How is it going to affect our environment? And so they're not aware, they are not aware that this is happening and we have those challenges (Participant 4)*

There is a limited understanding of the current state of the environment and human health, and the impacts of poor waste management practices. Consequently, there has been limited action (responses) that have meaningfully addressed the challenges with waste management in Grenada. Lack of awareness of environmental and human health pressures and impacts results in waste management not being a priority issue for the government, as citizens are not using their voices to ensure that money is allocated to support the issue (Participant 4).

The results indicate that data collection on the state of environmental and human health related to waste management is absent or sporadic in Grenada. Therefore, government and civil society are limited in their abilities to identify and respond to environmental and human health impacts, including impacts from poor waste management practices. The *shock* value is missing. If the GSWMA or civil society was aware of the precise health implications (i.e., incidence of asthma,

dengue in surrounding communities) of open dumping, action would be unprecedented. Through the research process, it became evident that data collection is absent or sporadic, data and information access is limited and not publicly available, and when data is available, it is not necessarily used in environmental decision making.

In most cases, data is only collected in connection to a development project with external funding, and this data tends to be collected by external consultants. For example, despite the majority of waste entering the dumpsites co-mingled, waste audits have only been conducted (or at least reported) as part of a waste management project. To date, the GSWMA has hired consultants to complete three waste audits. Following completion of the 2003 characterisation, Dillion Consulting recommended completing a 'dry/tourist' season characterisation program and combining with the results from the National Waste Management Strategy (Government of Grenada, 2003). To my knowledge, GSWMA employees have never developed waste audit capacity internally, and waste audits at either dumpsite have not been conducted regularly. This represents a pertinent gap in data required for waste management decision making.

The GSWMA, Ministry of Health, or Ministry responsible for the Environment are not required by law to collect data about pressures on the environment and the state of environmental and human health. Open dumpsite in Grenada, as well as informal waste dumping, are environmental and human health concerns. To the researcher's knowledge, however, data on marine, land and air pollution at the dumpsites is not collected. Participants at the Ministry of Health (Participants 13) alluded to some efforts to collect data on the location of informal dumpsites and derelict vehicles, but this data was not available at the time of the field work. Nimrod et al. (2013) provided scientific evidence of nutrient loading in the Salle River and Halifax Harbour, directly adjacent to the Perseverance dumpsite; this data was collected for a marine conservation monitoring project and is not collected regularly. To date, the researcher is unaware of any efforts to collect data related to human health. For example, data on working conditions and health implications for informal workers (i.e., waste pickers) at Perseverance, or human health indicators such as vector-borne disease prevalence or asthma from air pollution in the surrounding communities are not collected.

There are limited mechanisms for researchers and civil society to access existing information and data in Grenada. On several occasions, I was privileged with information that several participants indicated that they themselves would not necessarily have the means or time to access. As the research participants were directly involved in government and waste/environmental management,

this sentiment was alarming and unexpected. Grenada has not yet enacted the draft Freedom of Information legislation (Government of Grenada, n.d.), therefore limiting recourse for concerned citizens and officials alike who seek environmental information. For example, Participant 24 indicated that there is no formal procedure for commenting or consulting draft legislation and policy; sometimes documents are deemed privileged and other times they are not.

Relevant policies and historical environmental and waste management information is not readily available, and the government does not have any formal mechanism to publish environmental information. For example, the researcher was unable to acquire a copy of the report *'Solid and Ship-Generated Waste Management Project – Model Policy, Legislation and Regulations; Final Report – Grenada, July 1999'* from the Ministry of Health, Legal Affairs, Physical Planning Unit and the GSWMA. This report is directly cited in the Third Schedule of the Waste Management Act as the established standards for Landfills, Compost Facilities, Recyclable Materials Processing, and Incineration Facilities in Grenada (Government of Grenada, 2001). This schedule is directly applied in the Act six times; for example, knowledge and application of the standards is directly impacts the Planning Authority's ability to approve waste management facilities, and the standards in which facilities must be built to and maintained by the applicant (including the GSWMA) (Government of Grenada, 2001, sec. 14(5) and 16 (1,2)). It therefore contains pertinent information about the legal requirements for private sector and government agencies conducting waste management activities. As the responsible parties were unable to provide a copy of the report, it is conceivable that that there is no digital record, and the legally required standards are not being used in practice for developing waste management infrastructure. Consequently, while there are calls to implement regulations and standards via the Waste Management Act, some standards do exist, they have just been lost or inaccessible.

Similarly, copies of the GSWMA Annual Reports including financial statements are to be published in the Gazette (Government of Grenada, 1995a, sec. 21D); these documents are currently not published digitally by the GSWMA. Hard copies were available to the researcher through the partnership with the GSWMA but due to the difficulty of accessing print copies, only reports from 2014 to 2017 were acquired. An annual subscription to the Government Gazette would normally be required to access these reports, with subscription rates of $EC 600 and $EC 300 (including legislation and excluding legislation, respectively).

In Grenada, legislation is not readily available to the public. At the time of field work, accessing copies of recent legislation, like the Non-Biodegradable Waste Control Act (2018), amendments, and statutory rules and orders (SROs), was only possible after acquiring an email address to communicate directly to the Drafting department. Observations indicated that lack of access to official legislation has the potential to cause significant confusion amongst civil society. For example, in 2018, I observed that both the public and officials were having a hard time getting access to the Non-Biodegradable Waste legislation; this resulted in significant confusion on the relevant dates of enforcement as well as materials being banned under the Act. Furthermore, conversations with citizens and participants indicated frustration with lack of enforcement of the Litter Abatement Act (Government of Grenada, 2015c). The Act, however, clearly states that it is not enforceable until commenced by the Minister; the minister only commenced the Act in 2019 (Government of Grenada, 2019). Consequently, frustration with lack of enforcement was misplace, as the legislation, until 2019, was not actually enforceable. Recently, the Government has updated their website to include legislation from (2011-2018).

In Grenada, when data is collected, it is not necessarily or systematically used in environmental decision making. Lack of capacity and technical knowledge plays a role in the ability to collection and maintain data management systems, as well as being technically apt to analyze the data to inform decisions. While waste generation rates are calculated annually to fulfill requirements for the GSWMA Annual Report, data collected at the Perseverance weighbridge is not used regularly for monitoring purposes. Upon acquisition of the waste weight records, the data required extensive cleaning and standardization to make it useable. This indicated that weigh-records were not accessible for day-to-day decision-making, as it is inconceivable for managers to spend days-worth of working time cleaning the data. Furthermore, on a couple of occasions, the GSWMA became interested in how I was processing the data for the material flows aspect of this dissertation (Chapter 4). The GSWMA then requested help with providing insights to inform decision making related to private contractors and the potential for commercial tipping fees. At the time of field work, there was no middle management or analyst positions at the GSWMA; therefore, no employees were specifically responsible for data management, including processing, monitoring and assessment (Participant 4). Similarly, another participant indicated that the Ministry of Environment had no technical staff that reported into the manager; an absence of technical staff resulted in minimal or absent data collection and reporting for the number of multilateral environmental agreements that Grenada has signed on to and explains why Grenada lacks capacity to support pollution related

MEAs, like the Basel Convention. Ultimately, this had led to policy makers challenged with how to response to problems:

> *Generally, policymakers, PSs, administrators … realize, okay, we have a problem. How to solve it? Because we conclude already that it is a problem. Perseverance cannot continue to grow as a mountain. But how will we solve it? I think we all have an open mind to the process, but we don't have the knowledge to inform decision. (Participant 18)*

Throughout the field work, it became evident that institutional knowledge at the GSWMA and ministries were held at a sectoral level, and only within their individual units (Government of Grenada, 2012c). Information was often held informally and without written record. At the time of field work, the rich contextual 'on the ground' information held by zonal supervisors was reduced to tallied observations recorded on paper and not digitally transcribed. Zonal supervisors possess a rich set of information related to the performance of waste collection companies, quality service, as well as 'problem areas' that have ongoing issues with illegal dumping. It was not clear that management was aware of many of the insights collected informally by zonal supervisors, and therefore neither management nor the Ministry of Health could improve processes or enforce legislation related to dumping locations, problematic public bins, and problematic collection routes.

## 5.5 Global governance participation

Participation in global and multi-lateral environmental agreements is a means for governments, especially small island states, to access funding to strengthen sustainable development (Participant 24). Environmental management, and waste management in the Caribbean, is guided by several multi-lateral environmental agreements: the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, the Cartagena Convention on Land-based Sources (LBS) of Marine Pollution Protocol and the International Convention for the Prevention of Pollution from Ships (MARPOL), the Declaration of Barbados and Programme of Action for the Sustainable Development of Small Island Developing States, and St George's Declaration of Principles for Environmental Sustainability in the OECS. While Grenada does participate in some regional and international environmental governance frameworks, participation in global pollution agreements is limited.

> *Grenada is not signature to a lot of the multilateral environmental agreements. For example, the Rottenham, Stockholm, Basel, and a couple of others. Right now, we are ratifying or we're waiting*

> *on the final report to see if the government is going to ratify this final report for the Minamata Convention, which has to do with Mercury exposure and disposal (Paricipant 26)*

The same participant indicated that Grenada's participation in global governance frameworks is limited by capacity and reflective on opportunities that the Governments sees for funding and providing cross-sectoral benefits, including driving economic growth. Consequently, global agreements that are more 'regulatory', that is controlling economic development and ensuring environmental protection, have not yet been ratified in the state. These global or regional agreements often provide capacity and funding to implement (Participant 24), consequently there are benefits to pursuing ratification.

| | **Grenada** | Antigua and Barbuda | Bahamas | Barbados | Dominica | Guyana | Saint Kitts & Nevis | St. Lucia | St. Vincent & Grenadines | Suriname | Trinidad and Tobago |
|---|---|---|---|---|---|---|---|---|---|---|---|
| International Convention for the Prevention of Pollution from Ships, or MARPOL Convention: | | | | | | | | | | | |
| • Annex I – Regulations for the prevention of pollution by oil | **X** | X | X | X | X | X | X | X | X | X | X |
| • Annex II - Regulations for the control of pollution by noxious liquid substances in bulk | **X** | X | X | X | X | X | X | X | X | X | X |
| • Annex III – Prevention of pollution by harmful substances carried by sea in packaged | | X | X | X | X | X | X | X | X | X | X |
| • Annex IV - Prevention of pollution by sewage from ships | | X | X | X | | X | X | X | X | X | X |
| • Annex V - Prevention of pollution by garbage from ships | | X | X | X | X | X | X | X | X | X | X |
| • Annex VI - Prevention of air pollution from ships | | X | X | X | | X | X | X | X | | X |
| Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (WCR), or the Cartagena Convention (1983), supported by three protocols: | | | | | | | | | | | |
| • Protocol Concerning Co-Operation in Combating Oil Spills in the Wider Caribbean Region (1983) | **X** | X | X | X | X | X | X | X | X | | X |
| • Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region (1990) | **X** | | X | X | | X | | X | X | | X |
| • Protocol concerning pollution from Land-Based Sources and Activities (1999) | **X** | | X | X | | X | | X | | | X |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Global Pollution Conventions: | | | | | | | | | | | |
| • Minamata Convention on Mercury (2013) | | X | | | | X | X | | | X | |
| • Stockholm Convention on Persistent Organic Pollutants (2001) | | X | X | X | X | X | X | X | X | X | X |
| • Rotterdam Convention on Prior and Informed Consent Procedure for certain hazardous chemicals and pesticides in international trade (1998) | | X | | X | X | X | X | X | X | X | X |
| • Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal | | X | X | X | X | X | X | X | | X | X |

Table 5.4 Summary of multi-lateral pollution and waste agreements
Adapted from (Clausen et al., 2020; International Maritime Organization, 2021; UNEP, 2019c)

## 5.6 Chapter conclusion

To date, the GSWMA has largely focused on end-of-pipe solutions. This is most recently evident in the 2020-2021 construction Perseverance sanitary landfill, and goals of the GSWMA to improve collection, improve disposal facilities at Dumfries and the reduction in littering and illegal dumping (GSWMA, 2020b). Currently, the economic costs of polluting are both negligent and stagnant, yet the real costs to the environmental and human health is unprecedented. There is a growing environmental and social cost with dumping waste in an open dumpsite. Polluters – especially non-households – do not pay *any* costs to society, let alone the true social and environmental cost associated with Perseverance or Dumfries; therefore, the costs of pollution are downloaded (unjustly) to future generations.

This Chapter has demonstrated the need for improved governance in Grenadian waste management by addressing the implementation and enforcement of penalties and levies, development of regulation, policies and management plans and implementing EIAs to assess waste management projects. Both improved use of data and engagement with global governance frameworks can provide the motivation and capacity to implement such initiatives. Yet, none of these initiatives and improvements to the governance structure will be realized without adequate engagement and support from the public.

> *To ensure that their enthusiasm, commitment, energies and ingenuity are harnessed, it is important to make certain that the national framework, sector plans, and in fact all aspects of environmental programming are sensitive to local priorities and resources. Environmental initiatives at the national level if they are truly to be sustainable, must have a dimension that strengthens local communities and optimizes human resource potential at the grassroots level, the true environmental frontier. The effort required to Mount this top and bottom level strategy is clearly greater than that required to issue a few national guidelines. But the ultimate return on investment of the time and energy will not only be much greater, but it is the only way truly sustainable development can be achieved in a Democratic society (National Plan Secretariat, 2019; The Caribbean Conservation Association, 1991, p. 265)*

A systematic approach to resource management requires multi-level governance whereby Grenadian authorities need to work, and collaborate with, international bodies, other Caribbean Island states, and with the local population. The next chapter addresses the value that public participation brings

to improving Grenada's waste management system, which is critically important for Grenada's national goal of "putting people at the centre of sustainable development and transformation," as per the National Sustainable Development Plan – Goals and Outcomes (Table 5.5).

| National Goals | National Development Outcomes |
|---|---|
| High human and social development: putting people at the center of sustainable development and transformation<br>Vibrant, dynamic, competitive economy with supporting climate and disaster resilient infrastructure.<br>Environmental sustainability and security | 1. A healthy population<br>2. Educated, productive, highly skilled, trained, and conscious citizens<br>3. A resilient, inclusive, gender sensitive, and peaceful society<br>4. Broad based, inclusive, and sustainable economic growth and transformation<br>5. Competitive business environment<br>6. Modern climate and disaster resilient infrastructure<br>7. Climate resilience and hazard risk reduction<br>8. Energy security and efficiency |

Table 5.5 National sustainable development plan, goals and outcomes
Source: (National Plan Secretariat, 2019).

# Chapter 6 Results: The value of public participation

## 6.1 Introduction & chapter contributions

Despite its importance in fostering an effective and transparent waste management system, the functional role of public participation in the management of waste in Grenada is not well-understood nor considered. The legitimacy of governance structures could be strengthened by meaningful consultation with citizens, and effective citizen participation at all stages of waste management decision-making. This local democratic framing is particularly important as the GSWMA enters a new chapter of waste management that includes implementation of integrated solid waste management ('ISWM') and an updated waste management strategy[24], and therefore should be seeking a legitimate governing process for waste management.

Every human situated in Grenada participates in daily, incremental accumulation of waste materials at the Perseverance and Dumfries dumpsites. Therefore, everybody, through everyday actions, choices, and participation, contributes to environmental change of the island (Kothari and Arnall, 2019). Yet, the "everyday" actions are not widely investigated in waste management research to date (Chapter 2). As the results of Chapter 5 demonstrated, public participation in environmental matters are not adequately legislated in law (e.g., Freedom of Information Act), nor are they enshrined as a constitutional right in Grenada (ECLAC, 2018b). The results presented in Chapter 5 of this dissertation indicated that experts, including GSMWA officials, are frustrated by the everyday actions of citizens; yet there has been little evidence of a two-way dialogue to understand the root of this frustration. It is critically important to investigate citizen habits and behaviors, as well as their actions related to stewardship (Kothari and Arnall, 2019; Maniates, 2012).

Through my conversations with both expert and citizen participants, a comparative lens to the 'big countries' was often held up to Grenada. One of the participants, who was interested in studying waste management, asked me the source of my motivation. After answering the question, I posed the same question back to the participant, and their answer exhibited frustration and sadness, and a desire to implement 'big country' initiatives:

> *It's just really sad to see a small island like Grenada. And when you compare it to some of the developed countries, how they deal with their waste, I just think that we could apply some of the*

[24] At the time of the research, the ISWM project, including a key outcome of the waste management strategy update, was not yet released publicly.

*same steps of proper management.* ***'Cause it's a very small island and we do a shitty job.*** *(Participant P).*

As a researcher from a 'big country', this was challenging to hear for me. From my vantage point, these 'big countries,' including Canada, have exacerbated waste management issues: 'big country' exports of materials and food in plastic packaging; hotel investments that damage the environment and intensify land to satisfy desire of tourists for cheap vacations; and the application of unsustainable or inappropriate technology and 'development' through 'big country' consultancies that provide 'expertise' while ignoring local knowledge. To me, Grenadian waste management was hindered by comparing itself outward, instead of looking inward for solutions.

This chapter asserts that public participation forms an important basis for effective waste management decision making and strategy, as it is a key aspect of forming legitimate governing structures and institutions. As the public is a key participant in everyday waste management practices, it is critically important to understand habits, behaviors, perspectives, and concerns of citizens. To understand the role and potential contributions of citizens in waste management, I undertook a grounded, "bottom-up" investigation of the challenges and opportunities for Grenadian waste management. This chapter addressed the fourth research question, Q4: *From a citizen's perspective, what are challenges in an island waste management system?* From our conversations emerged a plethora concerns and challenges, ideas for ameliorating or improving the situation, and feelings of hope and dismay. Research participants depicted a variety of perspectives; but, generally – and most importantly - they demonstrated the importance of citizen participation in waste management governance and social metabolic research.

This chapter begins with a brief overview of public participation in waste management in Grenada, drawing from both first-hand experience and historical evidence. This section (Section 6.2) provides the basis for seeking public participation in my research. I then present the results from citizen interviews, newspaper analysis and observations. The results are organized around three roles that Grenadian citizens play in the waste management system: as participants and enablers of waste management; as stewards of the environment concerned with their health, environmental justice, and pollution in their communities; and as islanders offering local knowledge, innovation, and insights into what is possible in Grenada. By organizing the results in this manner, this chapter offers a glance at what could be gained through a more representative, nation-wide consultation, and

looking inward – instead of outward – for solutions to sociometabolic risk associated with waste management in Grenada.

## 6.2 The state of public participation in waste management in Grenada

Without adequate and informed public participation in planning and implementation, waste management projects, initiatives, and desired everyday practices cannot be sustained. Despite provision for public participation in multilateral agreements, Caribbean waste management systems has been typically dealt with via a command-and-control approach through public health directives and legislation:

> *The problem is that in the Caribbean there is generally a lack of formal procedures and guidelines for the public participation and consultation and this naturally contributes to inefficiency in use of resources and to project risk. (Squires, 2006)*

In conversations with waste management and environmental management experts, one participant indicated that consultation in Grenada has typically been procedural and lacking substantive, collaborative investigation (Participant 24). Throughout the field work, I found limited recent evidence of effective public engagement in waste management decision making in Grenada. This does not necessarily mean a complete lack of public participation; rather, it suggests that engagement is characterized by lacking advertisement in the newspapers or online media, and occurring for a targeted audience (i.e., occurring only in communities directly adjacent to the project site, instead of nation-wide); lacking transparency and follow-up in the form of documentation and record keeping; conducted in a prescriptive manner (i.e., communicating what will be done oppose to communities informing decisions at all levels of a project), and lacking two-way dialogue.

This was the case for one consultation process that I observed in Carriacou. The GSWMA management and board members visited the Dumfries dumpsite and heard from the Member of Parliament and Minister of Carriacou and Petite Martinique Affairs and Local Government on waste management issues (Field notes, November 29, 2018). While there was an open forum for the public, it was not well-attended nor substantive in terms of opportunities to meaningfully contribute to the plans for the Dumfries site (Field notes, November 30, 2018).

There is evidence of public participation regarding the selection of the location of the now-collapsed Perseverance landfill as part of the World Bank project in the early 1990s (Rosenberg and Korsmo,

2001; Squires, 2006). Following the initial environmental assessment, at a consultation in Happy Hill, a member of the public informed the World Bank about the presence of the endemic and endangered Grenada Dove in the Perseverance area (Rosenberg and Korsmo, 2001). The initial environmental assessment conducted by outside environmental assessment experts did not include considerations of the Grenada Dove, demonstrating the limited utility of relying on "highly qualified environmental professionals and the benefits of drawing on local knowledge (Partridge, 1994, p. 19). The contribution by one member of the public became controversial, however, as key questions emerged about the merits and representation of a single voice, the motivations of the person that spoke up, and the merits of delaying a much-needed landfill based on this evidence (Rosenberg and Korsmo, 2001). Despite polemics, the World Bank insisted on further investigating how to mitigate the impacts on the Grenada Dove. The World Bank hired JECO[25], a local consulting firm to conduct a site assessment which include "substantive local input at each state of the process" (Rosenberg and Korsmo, 2001, p. 292). According to the authors, and perhaps obvious to the reader, the benefits of hiring a local consulting firm were numerous: knowledge of local institutions and political culture; determined effort to increase public participation through house-to-house invitations and advertisements on the radio; use of "town crier" announcements using mounted speakers while driving through communities; and use of the consultant's personal environmental awareness radio show to increase awareness of the project (Rosenberg and Korsmo, 2001).

Consultations in the Perseverance (Brizan and Concord) and Telescope areas demonstrated a noticeable difference in communities' abilities to participate in public consultation, as reported by Rosenberg and Korsmo (2001). The authors noted that residents of the Perseverance area (Brizan and Concord) voiced concern the Grenada Dove and other significant environmental flora and fauna, including the mangrove swamp, but did not demonstrate an affinity for political activity. As such, organized opposition to the landfill was minimal. Furthermore, several residents relied on the existing dump for scavenging recyclable materials. The authors noted that residents were given assurance that the new landfill would be "sanitary, adequately equipped and managed…a vast improvement over the existing situation" (Rosenberg and Korsmo, 2001, p. 293); this is a promise that has yet to be fulfilled over 20 years later (Chapter 4, 5).

[25] JECO was contacted on April 2nd, 2021 – remove

In contrast, the Telescope community formed a clear, strong public objection to the creation of a landfill and development of a transfer station in the area (Rosenberg and Korsmo, 2001). The residents presented the consultants with a 700-signatured petition against any development of waste infrastructure. Affluence, experience abroad, and political clout of the residents were suggested as being instrumental in opposing any waste infrastructure development at Telescope (Rosenberg and Korsmo, 2001). Ultimately, JECO concluded that Perseverance was the best site for a new sanitary landfill, in line with the initial siting recommendations. But protection of the Grenada Dove became an explicit objective in the OECS Solid Waste Management project (The World Bank, 2003b).

> *In Grenada, as in much of the Eastern Caribbean, the use of participatory methods of policy making and implementation in is [sic]the early stages of development. There is understandable resistance both in the OECS and the Grenadian government to programs, processes and methodologies imposed from outside. Nevertheless, there is growing awareness that the thorough, thoughtful and appropriate use of certain participatory methods are not only beneficial, but necessary for the sustainability of critical environmental values. (Rosenberg and Korsmo, 2001, p. 297).*

Despite learnings on the importance of public participation, there is no evidence of community consultation conducted with regards to installation and rehabilitation of the collapsed Perseverance landfill and remediation of the currently used Perseverance dumpsite, as part of the Integrated Solid Waste Management project. This may be due to the lack of clarity around legislative requirements for participation and environmental impact assessments in the Waste Management Act (Chapter 5). Recently, the GSWMA held an online public meeting on their Facebook page (GSWMA, 2020a), as well as provided the public with updates on the construction of the landfill, but lack of evidence suggests that there has been minimal, two-way dialogue between the GSWMA and the public regarding the most recent iteration of the Perseverance landfill.

## 6.3 Citizens as participants in the waste management system

Citizen participation in the waste management system, that is in their waste generation, separation, and collection, should inform how the waste management system is designed and implemented. In this section, I present the results organized around how citizens generate, sort, and put their waste out for collection. A summary of these findings is presented in Table 6.1.

### 6.3.1 Waste generation

Through modernization, access and economic growth, waste generation patterns have shifted in Grenada.

> ***...50 years ago, there was no waste****…There was literally no waste…[Now] everything we throw away…because it's packaging, it is wrapping.*

This shift in consumption, without a shift in management, has left islands, like almost all other social ecological systems globally, unable to cope with the influx of non-biodegradable materials.

> *So, the islands could never cope with what's resulted… when you ate a banana, you threw it on the ground because it disintegrated. There was no waste. [But now the banana comes… ], the banana comes back [from the store] in a plastic bag. (Participant 10)*

Participants felt that the amount of waste being generated in Grenada was too much, unbearable, and needed to be reduced (Participant G, M). In an ideal waste management system, citizen would generate *as little as possible* through waste reduction strategies like rethinking consumption, refusing plastics, and diversion through composting and recycling (Participant A, B, D, N; Focus Group A, D, E).

> ***I find like some people generate too much waste****. There should be a way that you try to get people to use less things that would need to be disposed of at the dump. Some of the things are unnecessary... (Participant, Focus Group A)*

Participants suggested ways in which they themselves have reduced the amount of waste that they generate, beginning with refusing to buy or use items. For example, several participants indicated that they thought people should make more of an effort to reduce plastic bags consumption, and they themselves tried to refuse plastic bags at the supermarket and "go with our reusables" (Participant B, C, D, J, M; Focus Group C, D, E). At the time of field work, it was normal for patrons to use a plastic bag, even for small items like a plastic drink bottle. Participants indicated that cashiers assume that you need a bag, and it was abnormal to not take a bag (Focus Group C); this directly aligned with my own experience of purchasing groceries. One challenge, however, is that Grenadians reuse single-use shopping bags for disposing of waste, such as household waste and wrapping up soiled diapers (Participant D, F). As field work occurred prior to restricting single-use plastic bags, I was not able to observe how Grenadians now disposed of their waste and any changes

in habits because of the legislation. One participant suggested that the ban would allow Grenadians to start *thinking differently* about the ubiquity and harmful impacts of plastics (Participant A).

Two participants indicated that they made a conscious choice to limit their bottled water consumption, but when it was necessary, they purchased GlenElg bottles, even if they were more expensive, knowing that they could potentially 'recycle' the materials through dropping off at the collection site (Chapter 5) (Participant D, Q).

| Main finding: | Participants | Sample quote from participants |
|---|---|---|
| Citizens generate too much waste; need to reduce consumption and implement smart consumerism. Some citizens make decisions to avoid or refuse consumption of items, divert materials as much as possible. | Participants: A, B, C, D, F, G, J, M, N, Q<br><br>Focus groups: A, C, D, E, G | "People have too much garbage so the trucks full before it can get up the island to pick up the people in the North. So that happens and people just leave it on the roadside, the dogs will come, rip it open, begin to spread around, ends up in the drains, plugs up the water systems, or they burn it. And then all the plastic toxins are ending up in the atmosphere." (Participant M) |
| Everything is co-mingled. Ideally, waste is sorted to be used as a resource. Many Grenadians put organics back on the land, but composting is not as popular amongst younger generations or people who do not have access to land. | All participants<br><br>All focus groups | "So firstly, I would think segregation of collection. So, you're gonna have paper, metal, plastics, classified batteries, acid, oil, tyres. I don't know what you do with acid, oil, and tyres at the moment. But a requirement of safe separation segregation. Secondly, those that have made it easy financial incentives to have recycling equipment, plant, factories. As long as there is some point to it because a lot of recycling." (Focus Group A) |
| Grenadians are open to sorting their waste, especially if there are clear benefits or incentives, such as monetary payments, employment outcomes, or access to compost. | Participants: D, N, P, Q<br>Focus groups: A, B, D, F | "You know, organic food is a huge now. People would buy organic food from Grenada, if we had it, at a manageable level, and the price is good. Solid waste to do their own, organic [compost] and sell it back to us in bags." (Focus Group G) |
| Grenadian like to take their waste out every day and do not like to store waste in their house. There is disagreement on whether this is a 'bad habit' or if collection should be improved to accommodate. Daily collection or options to drop off at a transfer station were recommended | Participants: A, B, D, E, F, G, H, M<br>All focus groups | "People should have their garbage at their home. [Wait for the] scheduled for pickup. Instead of taking it by the road" (Focus Group E)<br>"…I just want to throw it out, I don't want to wait for next day." (Focus Group E) |
| Collection of waste is unequal around the island; some residence experiencing poor collection service, while others experience reliable collection service. Some contractors provide barrels for waste, while others remove barrels. Affluent communities have access to barrels or bins and have personal collection, while other communities do not. | Participants: A, B, F, G, I, M, P, R, S<br><br>Focus groups: B, C, D, F, G | "…it's satisfactory … what I have seen, it's quite good. They come twice a week. Most importantly they are very punctual. You know, the time … that you expect them, they are there, and they take the waste away." (Participant S) |
| Inadequate public bins and waste receptacles; removal of public bins for household waste in communities leads to overflowing public bins in other communities; lack of waste receptacles leads to littering. In contrast, other contractors | Participants: F, I, M, R | "I think solid waste should invest in what you call household bins. Every household should be assigned a bin. If you can't pay for it now, you pay for it later. Charges to your light bill. Charges to your tax system. Every household should be assigned one bin. And in the |

| | | |
|---|---|---|
| supply bins for citizens, and this was viewed as a good practice. | Focus groups: A, B, C, D, F, G | future, two bins. Start with one per household." (Participant, Focus Group G) |

Table 6.1 Main findings of citizens as participants in the waste management system


Figure 6.1 Packaging in the produce section at the grocery store.

Source: Author A) Mushrooms imported with excessive packaging, March 32, 2019, B) Styrofoam trays and plastic wrap applied to imported and local produce, April 5, 201, C) Scale for weighing loose vegetables in Petite Martinique, February 16, 2019.

Waste generation is dependent on purchasing decisions made by the consumer. For example, one participant indicated that they consciously chose to not purchase microwaves for their own home or rental cottage business because they felt that they were not needed (Participant B). After making this choice, they also learned from friends that microwaves are prone to breakdowns. This conscious choice contrasted with another participant's observation that people frequently 'update' appliances around holiday seasons; consequently, appliances are thrown out even if they are still working (Participant I).

As a small island state, consumers are limited to what is available on the island (i.e., decisions from the importer), as well as subject to packaging decisions made by the manufacturer, who is frequently a great distance from the island. One participant reflected on the complexity and challenges of trying to reduce their waste generation on an island, and that there is some waste that is unavoidable:

> *…you can't make everything yourself. So, you buy your tube of toothpaste, which is in a box, which is in a tube, and … [has] the little plastic seal on top...Sometimes we go into the marketing board, and, I unfortunately haven't managed to get those mesh bags for my vegetables yet. I try and just take them loose because, you know, if you don't need tons... that works fine, but what I find even worse is when it's Styrofoam and tons and tons and tons of plastic wrapped around and stuff. So, you can't always avoid it, even this local stuff. (Participant B).*

Observations in grocery stores indicated that plastic wrap, Styrofoam trays and plastic bags are widely used in the fresh food sections of the store. While some food packaging is imported (i.e., arrives in Grenada with the product inside) (Figure 6.1A), other packaging is applied in grocery store operations to facilitate ease of shopping, minimize product loss from handling by customers as well as affordability (e.g., cutting a large pumpkin into affordable chunks) (Figure 6.1B) (Field Notes, February 22, 2019). Several participants expressed frustration with not being able to get 'plastic-free' loose vegetables at the supermarket (Participant B, C, M; Focus Group G), and one participant suggested that you can request for 'Styrofoam-free' vegetables by talking to staff (Participant C). On several occasions, I was able to request unwrapped vegetables from supermarkets. On one occasion, I learned from the produce manager that 'sensitive' vegetables like tomatoes and zucchini are wrapped because people touch the fruit and bruise it (Field notes, February 22, 2019). On another occasion, I was able to get unwrapped carrots from a loose storage bin; when I asked why the displayed carrots were wrapped, the cashier indicated that they were using up packaging stock before the ban (Field notes, March 7, 2019). In Petite Martinique, however, onions, garlic and potatoes are

available in bulk with a portable scale in which the consumer prints the price (Field notes, February 19, 2019) (Figure 6.C). Consequently, some packaging is avoidable through consumers' and sellers' choices while other packaging is dependent on importers and product manufactures from outside of the country.

For some participants, there was a need to control the types of materials that were coming into the island; materials that could not be reasonably dealt with should be restricted from importation:

> *If you buy whitegoods, fridge, that sort of thing, it's in a cardboard box. But between the appliance and the cardboard, you have huge sheets of Styrofoam … I think we need laws that prevent exporters to Grenada* ***from inflicting on us something that we have no means of disposing of****, which actually nobody has any means of disposing of. So, I think we need laws to cope with that (Participant, Focus Group A).*

### 6.3.2 Sorting and separating waste

Most participants suggested that waste sorting and separation were an important component of an ideal and/or future Grenadian waste management system (19/19 participants and all focus groups). Likewise, lack of sorting was viewed as a major challenge in the current waste management system. Figure 6.2 demonstrates how four participants depicted sorting and separating waste in ideal and future waste management systems. A number of participants reflected on observations made abroad (such as US, Canada, or the UK) (Participant D, F, R; Focus Group D). For example, one participant indicated they had an epiphany while separating waste during a family visit:

> *The first time I saw it, I was in [USA State][26] by my family, and I was just putting it [waste] in the bin. And she's like, "no, we have three bins. This goes here, this goes here…" …I did not know this happened. And it was like an epiphany for me. I was like,* ***why don't we do this back home?*** *Because literally we put everything in one bag. And then you see everything on Perseverance. So, there is no separation at all (Participant D; Figure 6.2D)*

For several participants, separation was an important first step in dealing with the diversity of wastes. It is also the first step before waste can be recycled, composted, or disposed of harmlessly (Focus Group A). Waste separation has become more pertinent with a shift in the composition of waste in Grenada; waste compositions has shifted from more biodegradable waste to non-

[26] State is excluded to maintain anonymity of the participant.

biodegradable waste (like plastics). For one participant, an ideal waste system is where the materials can quickly decompose and return to the land: *"Everything goes back into the land, so you can grow more foods"* (Participant A). They reflected that a shift to more non-biodegradable materials has resulted in waste that needs to be "managed", instead of simply being returned to the soil.

> *…these plastics and rest of things that do not decompose,* ***that's where you got problems****, because now you got to think about the* ***management of it****, and where do you put it, and where do you store it, and is it doing any damage to the society on a whole? (Participant A)*

As an agricultural and rural country, many participants felt strongly that separating and composting biodegradable materials was an important aspect of an ideal waste management system (Participant A, B, C, D, G, H, J, P, Q, R, S, Focus Group A, B, D, E, F, G).

> *There's a lot of our paper and vegetative matter goes into Perseverance and it shouldn't, because our farmers need it. (Participant, Focus Group D).*

At the household level, several participants indicated that they themselves engage in casual composting (i.e., throwing it back on the land) and felt that it was 'ridiculous' to throw vegetable matter in a plastic bag and send it to Perseverance (Participant A, B, S; Focus Group A, G). Despite the pervasiveness of separating organic materials amongst the "engaged citizens", participants suggested that there is a generational difference, and more and more Grenadians are not returning biological materials to the land (Participant F, I, P, S; Focus Group B). One participant indicated that while older generations would throw ground provision peels[27] in their kitchen garden or the bush, the current generation (including themselves) put everything in the bin.

> *I know the older people will do these things. But you know we are the generation who just throw everything in the bin (Participant F).*

[27] Ground provisions is a term used to describe root vegetables like yams and sweet potatoes.

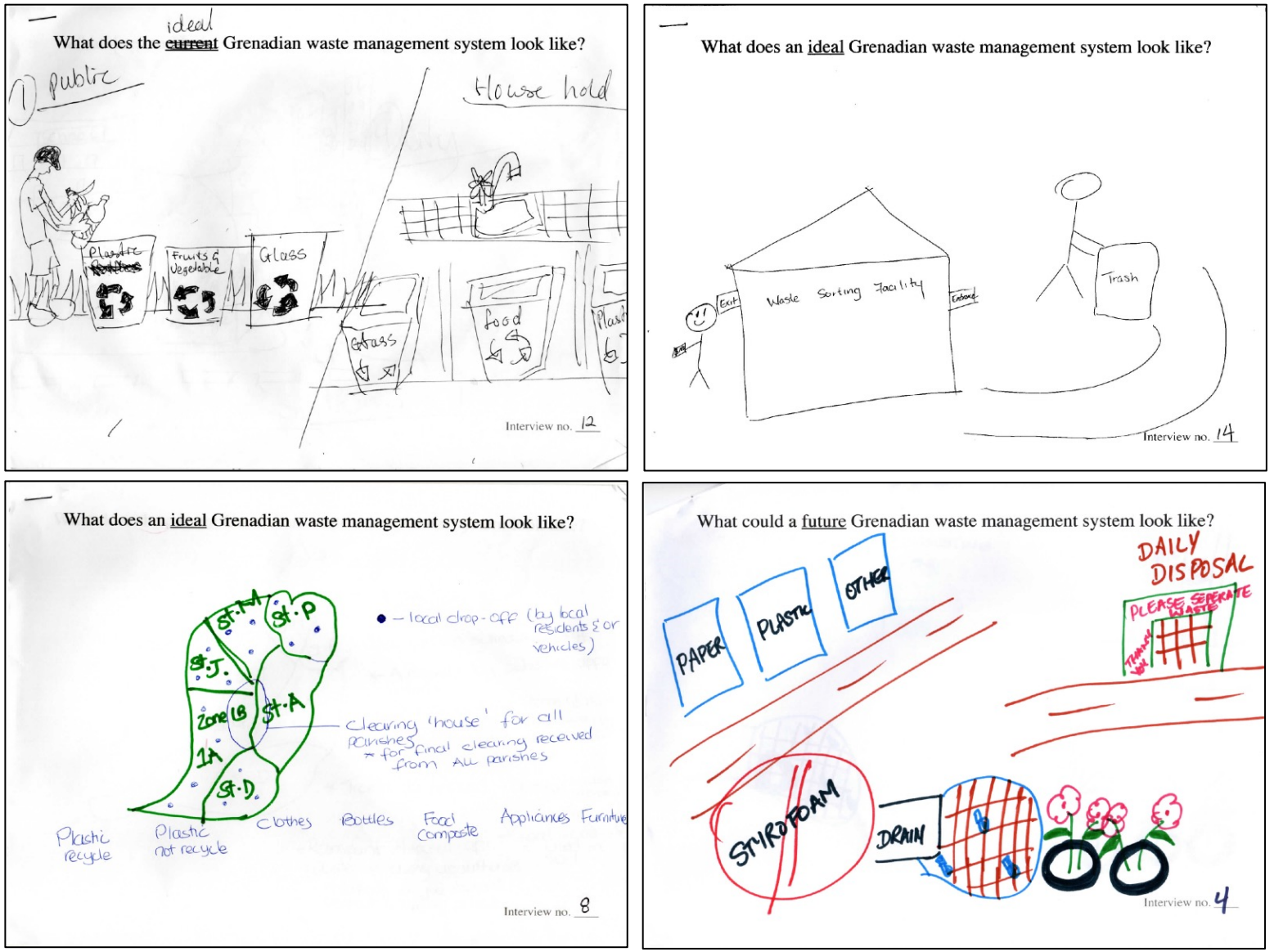


Figure 6.2 Ideal and future waste management systems depicting waste separation/sorting.
Envisioned by participants A) Participant L B) Participant N C) Participant H D) Participant D

This aligned with another expert participants suggestion that older citizens (50 years+) treat their waste in the "traditional Caribbean way" in which waste is separated and only a small fraction of items go to the dumpsites (Participant 18). As formal, institutionalized collection of waste management is a newer practice in Grenada (Participant 3), many Grenadians have grown-up managing their waste within their household through reuse, composting and household waste pits (Government of Grenada, 1995b). Older generations have a "reusing mentality" in which items like plastic bottles are reused as flowerpots (Participant 18). In contrast, younger generations are described as the *"**KFC type generation**. Where everything must be in a bottle. And they have what I call a **fast-food approach**. So, they buy food, they dispose of it without thinking, [without] making the link back [to the consequences]"* (Participant 18). As younger generations have had access to more formalized waste management services, it is conceivable that their approach to waste is different; younger generations have grown up with street cleaning picking up litter and formal collection of waste.

Households are now gardening less, and therefore composting less, and it is becoming *"…easier to just throw it away"* (Focus Group B, G). Participants suggested that waste production has changed because eating habits have shifted: people are buying more fast and processed food to eat on the go. For some participants, there is a generation of people that do not cook: *"Rather than making a meal, we go out and get it"* (Participant, Focus Group B), and this impacts type of waste being generated; this aligned with previous findings on generational differences in food consumption and waste disposal habits (Chapter 5; Participant 18). One participant indicated that they were surprised when they returned to Grenada from England after some time, and realized that people were putting organic materials in the bin:

> *I saw people putting their organic material into the bin. 'What you putting that there for? Put it back in the soil!' [they would say] **'Well, what do you think the bin there for?!'** So, another thing is that they are pleased to know that the waste can be collected. So, we make use of it. Without thinking of, you know, this is stuff that needs to go back in the soil. (Participant S).*

In other words, Participant S felt that Grenadians were too quick to use the bin and were not thinking about where the waste *should* go.

Participants indicated that once people had access to formal collection (i.e., when concrete bins were first built in Grenada), everyone put everything in the bin and this eroded *"old habit, our cultural habit of throwing it [in the bush]"* (Focus Group F). Government bins have been around for many years, but

regular collection commenced with the enactment of the GSWMA in 1995 (Government of Grenada, 1995a). One participant described the management of waste at their household (Box 6.1), and this aligned with findings from other participants who indicated that when they were growing up, waste was buried on their land because it was mostly biological waste (Participant S; Focus Group F).

> *"A typical household….Most people have a parcel of land, either behind the house or close by bush or wasteland. And people used to dispose their garbage on their property. I'll tell you what my father did because his father did it. We have two big holes on our land. One was for things from the kitchen, and the other one for metal and glass and other things like that. I would say about every five to six years it was covered because it was filled. And that site was moved to another hole….So, it was disposed on your property.* ***And of course, you always have careless people. They figure, they don't have time to dig a hole to cover it or they didn't have the land to store it.*** *So, those were placed in government bins, which were collected when government felt like it, or when the truck wasn't broken down. Public works and other people used to pass and pickup things and so on. So, it used to be collected and dispose of on your property. Some people still do it. A lot of us still do our own composting. I try to keep my kitchen things in my yard because I do gardening."* (Participant, Focus Group G).

Box 6.1 Description of 'traditional' Caribbean disposal

Particularly poignant in the quote in Box 6.1 is the association of using the public bin and *carelessness*; in previous times, prior to the GSWMA instituting collection, it was considered good practice to dispose of all waste on your household's land. Currently, most of the research participants considered it a good practice and made the effort to dispose of compostable materials on their lands, but like the quote about from Focus Group G (Box 6.2), one participant indicated that there are barriers to others trying to separate, including access to land (Focus Group D, E).

> *Some of us may have the patience to sort out our garbage. Some may not. And for instance, most of the people stay downtown...they don't have land to throw away the provision skins and stuff like that. (Participant, Focus Group D)*

Observations indicated that there are a lot of organic materials ending up in the dumpsites. For example, the coconut shells and other compostable materials from the St. George's and Grenville markets were destined for Perseverance (Figure 6.3). While observing waste collection on Petite Martinique, I noticed that biodegradable materials were being transported in bags of household waste by boat to the Dumfries dumpsite; this was interesting based on the observation that Petite Martinique appeared to be extremely dry and had a plethora of hungry goats looking for food (Field Notes, February 19, 2019). Participants and observations also indicated that de-bushing campaigns[28], organized by the Ministry of Agriculture, were sending large swaths of biodegradable materials to the Perseverance dumpsite (Focus Group B). Affirming results from Chapter 4, newspaper articles and observations indicate that biodegradable material represents a large percentage of waste entering the dumpsite and is connected to methane gas production and the fires at Perseverance (Ferguson, 2020; Hosten, 2017a). The GSWMA is regularly frustrated the citizens for putting out biodegradable yard waste (e.g., bags of grass) for curbside collection (Chapter 5; Participant 1, 3); but as numerous participants indicated, some citizens do not have options for composting.

Figure 6.3 Coconuts in St. Georges, March 8, 2019

The diversity of waste in Grenada means that a lot of hazardous materials are ending up in Perseverance. A few participants noted specific concerns with the disposal of hazardous or toxic waste in the dumpsites and the environment. One participant mentioned that paints are produced in Grenada[29], but lack proper means of disposal and are disposed in the dumpsite

[28] De-bushing campaigns hire citizens to remove vegetative matter from the roadsides.
[29] Sisson Paints, originally from Trinidad and Tobago, was purchased by the Donald MacPherson Group, a European manufacturer in 1974. Sometime after, operations were expanded to include the development of a Grenadian factory in the Frequente Industrial Park (Sisson Paints, n.d.)

(Participant B). An expert participant from the construction industry expressed similar concern, and confirmed that there was no means of disposing paint in Grenada (Participant 27). Other participants were concern with motor oil disposal into the environment (Participant I, J, R), and my own observations suggested that motor oil leakage into the environment is pervasive (Chapter 4). A retired pharmacist indicated concern for pharmaceutical waste that is ending up in the dumpsite or environment, with potential to leach into the waterways (Participant R), aligning with findings from Chapter 4 and 5.

The conversations about waste diversity and separation gave rise to several ideas for encouraging citizens to separate their waste. When asked if Grenadians were open to sorting their waste, participants indicated that it is possible and plausible to institute sorting and separating in society. Participants suggested a variety of education initiatives, infrastructure, and governance structures to motivate behavior. One participant suggested that sorting waste was a sign of a modern economy; therefore, both politicians and citizens would be open to the idea as it signaled modernity, in comparison with 'bigger' countries:

> *The country is growing. So, I think persons are trying… to modernize, as the bigger countries. So, I think they will be open to that. [It] will make you feel more [modern]. But even you know I think the government will be open to, in the sense that we're not Third World, if you understand, trying to get up to the level of the bigger countries. So, I think they will be into it. (Participant F).*

Several participants cautioned however that Grenadians have developed a habit of putting everything in the bin and developing a sorting mindset may take a while (Participant F, P; Focus Group D).

For a number of participants, education was seen as a key component of motivating behavior (Participant D, I, Q, R; Focus Group B, C, D, E, G). When asked "*What do you think is needed to get people to sort their waste?"*, participants suggested that citizens needed to be educated on how proper waste management, including sorting of waste, *benefits them.* Therefore, the GSWMA and the government need to demonstrate and communicate the environmental and economic benefits.

> *As Grenadians, I don't want to be negative, but the reality is it's either that I have to see what's in it for me, or it's by law. So…if I would get something back from what you are taking from me… like I'm going to get back … some bags of compost on my garden. It might be more of an incentive if I could see that I could get something back from it. (Participant, Focus Group D).*

Participants suggested that by separating and processing waste, Grenada could generate value added products to be sold to the local and export market (Focus Group A). For example, with biodegradable waste, participants suggested that materials could be used to create biofuel (Focus Group E), or farmers and gardeners could get access to local compost, instead of importing fertiliser (Focus Group A). Participants indicated that people are motivated to sort and return waste if there is an economic incentive:

> *So, if you have certain things in place to encourage person to get rid of their waste properly, and most of the time,* ***most of us like a little change in our pockets****. So, once there is some funds to be generated or if there is a there is an avenue that we can make some money from it, then a lot of us will jump onto it. (Participant, Focus Group B).*

Drawing inspiration from other regions, like Barbados, participants noted that the current $0.25 deposit on beer and malt drink bottles could be expanded to other bottles, like glass jam jars, as well as plastic bottles (Participant R; Focus Group A, B, C). One participant suggested that if people would receive money, they would be *"picking up plastic bottles like crazy"* (Participant, Focus Group B). Participants also indicated that the Grenada Bottling Company used to have glass bottles for Coca-Cola products that were returnable but has since switched to plastic bottles[30] (Focus Group B; also, Participant 23).

One participant indicated that establishing sorting behavior and a recycling center where waste is sorted would be aided if people knew that there was a benefit for their own lives or their family through employment:

> *So, everybody feels that if it's not me that's getting my job, my cousin is getting the job or my child gets to work on it during the summer, you know, they get to learn and stuff like that. (Participant H)*

In addition to education, participants felt strongly that the government needed to establish appropriate infrastructure to facilitate sorting materials. For example, for some participants, an ideal waste management system would have separate or compartmentalized trucks to collect different types of materials, and possibly varying collection days for different materials (Focus Group E). Other participants cautioned that not everyone will have the infrastructure in their homes to

[30] Unfortunately, I was not able to find the timeframe in which this switch was made from glass to plastic by the Grenadian Coca-Cola company.

separate waste; therefore, a key aspect identified by a focus group was to provide citizens with the coloured bins or bags to sort their waste (Focus Group F).

In urban environments, compostable waste may need to be collected if people do not have land space to set up their own composting. My conversations with participants indicated that there is an opportunity to *work with* households and businesses to collect and compost waste that cannot be composted at the household or commercial level; furthermore, conversations indicated that citizens are willing to separate waste and farmers are interested in organic compost (Participant P, Q; Focus Group A, F). Some participants felt that Grenada needed a company or formal system to collect compostable materials, especially from those who did not have land to compost or animals to feed food scraps to (Focus Group D). Others indicated that the government might have to make it mandatory: *"It's sad that we cannot use our consciousness and positive outcomes. [But] let's lobby for legislation"* (Participant, Focus Group D); this aligned with another participant's views that people should be required to put biodegradable waste goes back into the land (Focus Group A).

There is an opportunity to encourage composting and food recovery at the local level, as well as more formal systems in the urban environments (Ferguson, 2020). One participant uses coffee grounds from a local cafe to add organic matter and compost to their lands (Participant Q). Food scraps from the table can be set aside for pigs and dogs or composted (Participant N). Two different groups of participants suggested that they were willing and interested in setting up a composting facility for their community (Focus Group D, F). There was concern that despite living in an agricultural region of Grenada, their village sends a lot of biodegradable waste to Perseverance (Focus Group D). The participant expressed motivation to get funding to buy a shredder and set up a composter in their village and to educate the villagers on how to compost. The compost would be useful for farmers and kitchen gardeners in the community and allow the community to shred (invasive) bamboo that grows in the area (Focus Group D).

In addition to home infrastructure, participants indicated that citizens will not be motivated to separate their waste unless they see infrastructure, like a recycling plant, to process the waste.

> *…Sorting your waste, like … plastics, papers, you know, bottles, glass bottles...* ***But to what end.*** *Even if you sort your waste, they all been collected in probably the same truck and go to the same point. There is nothing at the waste disposal plant when the waste gets there to do, even if you sort it. …But if you have recycling plants … so that's from some of the wastes… we use is*

> *then it can be filtered back in some other form, then that could create less, less waste than we use and obviously find some interest because obviously, we get in our waste back into some of the product and that might help us to dispose of our waste properly. Right, instead of ending up in the rivers and streams and ultimately in the beach and goes to the ecosystem and stuff like that. So, something that could be looked at in terms of waste management, recycling plants. (Participant, Focus Group B)*

In the current system, it is pointless to require citizens to separate recyclable materials from household waste because it all ends up in Perseverance. Therefore, participants felt that before the government considers new legislation to control people behavior, they need to develop a waste management strategy and design a system to deal with the waste:

> *I think they need to design a way to deal with the waste itself. Like having different facilities dealing with waste. Because if you tell them people don't throw this there, and then I throw it in the bin, it still goes to Perseverance. So that's defeating the purpose of waste management, so first they need to come up with a better management strategy. And then try to encourage the population to have proper practice. (Participant P)*

From my conversations with Grenadians, it was evident that they felt that Grenadians were open to sorting their waste, especially if they could see the benefit (either for themselves, or their community). It is also evident that there were some engaged citizens that would be interested in piloting projects in their community.

### 6.3.3 Waste collection

The GSWMA claims that 98% of Grenada receives household waste collection (Chapter 5), but there is an inequality of service, depending on the collection zone (Figure 3.8). Some communities experience frequent and timely services, while other areas experience a host of problems related to collection. In the current collection system, households and companies put their waste out for collection in a variety of ways, depending on the infrastructure in the community (e.g., presence of a public bin), infrastructure provided by the contractor (e.g., contractors providing barrels), their personal infrastructure (e.g., ownership of a barrel), the personal or household habits (e.g., whether they engaged in composting), the accessibility of roads in their community (i.e., can a truck access the community) and the level of service provided by the contractor (i.e., quality and care of service and internal contractor operations). In some communities, the narrowness of the road limits garbage

truck access; therefore, waste is placed in a central location close to a main road in a 'public bin' (Figure 6.4A). In other areas, the garbage truck can drive through a community, and therefore households place their waste by the curbside in either a plastic bag or in barrels (Figure 6.4B & C). In some collection zones, the barrels are provided by the contractor (Zone 4 and 5; Figure 6.4C), and in other locations, households provide their own barrels or collection bins close to their house. Evidently, the standard of service is not consistent across the country. One participant indicated that a consistent collection system around the country would be helpful: *"each community has different things. Each community collects different ways... some places people will come and clean up a little area. But it's never consistent."* (Participant, Focus Group G). It was clear from my conversations that the quality of service, and therefore the satisfaction with collection, was dependent on the contractor providing the services and the collection zone.

Participants from the parishes of St. Andrew's, St. Patrick' (Zone 3) and St. George's (Zone 1B) indicated that the collection service was inefficient, sporadic and unsatisfactory (Participant F, M, P, R; Focus Group B & F). Participants in St. Andrew's were frustrated with the current contractor due to frequency of breakdowns:

> *[Frequently] the garbage truck breaks down halfway to Perseverance… so that's an issue. Solid Waste needs to get a new contractor…because the trucks are not suitable. Half of the time the garbage falls off the truck. You will be driving behind the truck and garbage falling off [in Grand Etang[31]] (Participant, Focus Group B).*

The frequent breakdowns of trucks were confirmed by participants in St. Patrick's (Focus Group F). One participant indicated that on the previous Monday, the contractors were collecting waste at 8:30 in the evening, when the waste is supposed to be collected in the morning. Consequently, this makes it challenging for participants to put waste out on time, when they have no idea what time or if the truck is going to come on a particular day (Focus Group F).

[31] Grand Etang is a protected forest in Grenada.


Figure 6.4 Examples of curbside collection.
A) Public bin in Grand Anse, containing both household and commercial waste, December 13, 2018, B) Household waste hung on fence for collection, December 7, 2018, C) Barrel provided by GSWMA Contractor, March 22, 2019.

When bins are overflowing or not picked up for days, communities end up burning the rubbish as a means of disposal (Participant M; Focus Group B). One expert indicated that households burn garbage without consideration for their neighbor's health (Participant 8). At the time of field work, the contractor in Zone 3 was not collecting the waste on Levera Beach consistently.

> *Currently the pickup truck never makes it to Levera. So, we have big green bins, about four of them down there. All overflowing...You call, you ask them to come collect. They're busy, they don't have time. But everybody that lives down there doesn't have pick up, so they take their rubbish down to the beach and put it in those bins for pick up. Plus you have people going out for social cook outs, you know, they're kind enough to collect all their garbage up at the end and put it on the trash can, but then it just sits there. It rots, it smells, the dogs will come, it overflows. What eventually happens is the security guards will tip it out and burn it. (Participant M)*

Based on frustration with the quality of service, it was not surprising that for some participants, an ideal waste management system includes more reliable, on-time, and frequent (daily) collection. Several participants indicated that they would like more frequent collection to their communities (Participants D, F; Focus Group A, B, C, D, F, G).

Participants on the western side of Grenada, and in Carriacou and Petite Martinique (Collection Zones 4 & 5, respectively), in contrast, felt that the collection service was satisfactory and reliable (Participant A, B, G, I, S; Focus Group C, D, F, G[32]). Some participants were surprised to learn that this was not universal to the island (Focus Group D). In one focus group, the participants were impressed with the contractor on the Western side of Grenada, because even in the event of a family emergency, the contractor arranged for timely collection services. To these participants, the contractor's operations were sound: they minimized breakdowns by always having a mechanic at the contractor's compound, and they washed the trucks daily to ensure cleanliness (Focus Group D); these practices were confirmed through observation of the Zone 4 contractor's operations (Field Notes, November 23, 2018).

The GSWMA encourages all citizens to put their waste out *on time* (i.e., not before waste collection day) (GSWMA, n.d.). Despite pleas from the waste management authority (GSWMA, 2020d), Grenadians do not like to keep or store waste in their homes, and put out their waste frequently,

[32] Focus Group G, while situated in St. Georges, was with a group from all over the island. Conversations with this group demonstrated a similar pattern, with Zone 4 residents being satisfied with collection and Zone 3 residence being unsatisfied with collection.

often daily. This habit was characterized as a 'throw away' attitude by the GSWMA and Ministry of Health (Participant 5, 13). Several GSWMA employees felt that citizens did not take responsibility for managing their waste and ignored communication from the GSWMA instructing citizens to put waste out only on collection day (Participant 3, 7, 8 and 14). One expert reflected that institutionalized waste management (i.e., the formation of the GSWMA) is new to the Caribbean region, and citizens are not accustomed to being "responsible for managing" waste and adhering to collection schedules (Participant 3). As a result, there is a culture of everyone wanting a public bin in their community, so that they can get their garbage out of the house immediately after generation (Participant 14); but this becomes problematic because waste attracts rats and dogs, which makes bins a public health hazard.

This habit was observed in my own first-hand experience of living with a Grenadian and observing citizens from outside the community pulling up to the public bin close to my residence in their cars and dropping off their waste. This aligned with the practices of some of the citizen participants, who indicated that they frequently travel with their waste to find a public bin.

> *…I just want to throw it out, I don't want to wait for next day. We have a truck that pass our place twice a week, sometime during the week so ... put it out on the day they pass, but I'll go and throw it down the road on any other day (Participant, Focus Group E)*

One citizen indicated that waste has to be removed from her home quickly because it contains dirty diapers and food waste:

> *And that has to get rid right away but I have to wait Monday and Thursdays so sometimes when I'm coming down with my boyfriend I just drop it in the nearest bin. Nearest drum I should say. (Participant F)*

For some participants, putting out waste *immediately* after it is generated (i.e., everyday) was a habit that was rational and reasonable in a tropical environment, especially if they have access to a public bin. One participant indicated that *"… if I have rubbish, I just put it there. Whenever they pick it up, they pick it up."* (Participant A). Based on the frequency that this habit was mentioned by participants and observed in daily life, it is evident that *getting waste out of the house* is a rational response for Grenadians. This may explain why households and companies also elect to dump waste illegally in traditional dumping areas, instead of taking the waste to Perseverance or Dumfries or waiting for collection. The practice of putting waste out immediately may also be motivated by possible health

concerns related to storing waste, particularly biological waste, inside dwellings in a tropical environment. Furthermore, Grenadians have a long history of managing waste immediately on the homestead property. Waste in a public bin, away from the house, may be viewed as a better option from the perspective of householders. Therefore, while waste management professionals may view this as a problematic practice by households, it may be viewed as a healthy and rational practice by people that do not have the household infrastructure to sort their waste (e.g., urban dwellers without access to land to compost) and are concerned about health implications of storing waste in the dwelling.

In contrast, some participants indicated that people should store their garbage in their homes until collection day as to not overflow the bins or attract dogs and vermin (Focus Group E, G). One of the problems with sporadic or unreliable collection is that when waste is left out, it attracts stray dogs (Participant D, M). One participant suggested that it was important for participants that citizens put out their waste in a way that discourages dogs:

> *We know that dogs are a problem, but we just put it in the flimsy plastic bag and put it where the dogs can easily get it. You know, and then obviously the dogs going to wreak havoc with the bags. At the end of the day when you get up, your yard is littered with waste, the road is littered with waste. And it just sits there, you know so all this creates an issue and it's throughout the country, you have problems with stray dogs, and dogs scavenging through waste. (Participant, Focus Group B)*

For others, however, the onus was placed on the contractors; participants felt that contractors had the responsibility to *show up on time* and provide bins or barrels to prevent dogs accessing the waste. As some participants pointed out, not everyone has the option of putting the waste out when precisely when the truck comes (e.g., people must go to work) (Participant F; Focus Group A, D); therefore, infrastructure needs to be in place to store waste before it can be collected. When reflecting on the availability of waste receptacles for household waste, one participant indicated that communities that are more affluent have less waste on the ground because there is more availability of bins, often privately owned (Box 6.2). This was supported by my own observation in Fort Jeudy, which was 'clean' in comparison to other areas on the island (Field Notes, April 7, 2019), as well as my observations of waste collection throughout field work.

Several newspaper articles indicated that overflowing bins and litter were a problem in communities, such as Frequente and St. John's River (Noel, 2013; The Grenada Informer, 2015). For participants, *more* bins instead of less bins were a practical approach (Participant R; Focus Group A, G). However, instead of developing more infrastructure, at the time of field work, the GSWMA has begun to remove concrete bins in communities to try and eliminate the problem of overflowing waste, stray dogs, and vermin infestation in communities. The GSWMA would prefer to remove bins where it is possible to access houses by road (WSP Caribbean Limited, 2018b). One participant indicated that as soon as a community road becomes traversable by a garbage truck, the bin is removed from the main road, and citizens are encouraged to put their waste out on garbage day at their dwelling (Participant 7).

> *"One is that my observation is that communities that are more affluent have less waste around. Because there's more availability around bins. That's a very, very practical thing. In Lance Aux Espines, there's literally [a bin at every house], and these may be personal bins that homeowners or landowners have.* ***Some gated communities have dozens of bins…****And then within the communities that are ...lower income, you have these community garbage disposal containers which are... not secure. They're placed sparsely. These persons have to walk to dispose their garbage. And the small team of garbage collectors within these communities are used to stopping at this main point. Whereas in the more affluent communities, they're willing to stop door to door to door to door and collect whatever garbage is there.* ***And so, this this lopsided approach helps to perpetuate the garbage in the urban areas.*** *(Participant, Focus Group A)"*

Box 6.2 Affluent communities have access to bins

Many participants mentioned the removal of the public bins as a problem; none of these participants felt that this was the right approach to solving the problem of overflowing waste (Participant F, I; Focus Group A, B, D, F, G):

> *… there next to no bins in St. George's or anywhere else. We used to have a system with concrete receptacles, but they attracted rats and smelled. Frankly, I think they were better than having nothing. And you could surely control the rats by putting out [waste] at the right times, using poison, even having a couple of cats in the neighbourhood. (Participant, Focus Group A)*

In some cases, these bins were being replaced with plastic or metal barrels; but in other cases, participants were expected to put their waste out *on time* by setting bags on the road or hanging on a fence. Participants indicated that when public bins were replaced with the same number of smaller plastic barrels, it further necessitated the need for more reliable, frequent collection (Focus Group B, D).

According to some citizens, the GSWMA *"does not like bins"* (Participant R; Focus Group B, F) and had discouraged community groups from installing litter bins and plastic barrels; this is supported through communication from the authority's website (GSWMA, n.d.) and confirmed by participants that the GSWMA felt that more litter bins would result in households putting out waste, instead of reserving litter bins for 'on the go' (Participant 7, 8). In St. Patrick's, participants indicated that both the contractor and the GSWMA does not like people to have their own barrels to put out their waste; they speculated that this was because the contractor would have to manually lift the barrels into the compactor truck (Focus Group F) and/or it would encourage the development of an overflowing bin (Participant R). Two participants indicated that the contractor in Zone 3 had removed their own barrels that they were using for putting out their trash (Participant R; Focus Group F).

In contrast, however, both contractors on the eastern side (Zone 4) of Grenada and in Carriacou (Zone 5) *provided* barrels for people to put their waste in (Figure 6.4C). Notably, these are the collection zones in which participants indicated satisfaction with the collection service. A member of the contracting company indicated that they supply bins to *work with* people's need to get waste out of the house immediately (Field Notes, November 23, 2018). While the GSWMA regards citizens' habit of putting out waste as something that needs to change (GSWMA, 2020a), one contractor appeared to be working with Grenadians successfully in their collection zone. Conversations with a citizen in Carriacou indicated that there are bins *everywhere* in Carriacou (Field Notes, February 13, 2019). One participant from a focus group[33] indicated that they had previously worked for the GSWMA contractor in Carriacou, and they felt that the island of Grenada would benefit from providing similar level of collection infrastructure:

> *…they have bins in specific places around Carriacou so you'd would walk a bit, couple blocks, and then there'd be a bin. Walk another couple blocks, and there's another bin. And [some] also have the concrete fence that they built on the side where all the big trash can go. So that could probably be a good idea for Grenada. (Participant, Focus Group[10])*

The participant indicated that it was the contractor's decision to maintain the infrastructure and provide the level of service. For example, the contractor would replace soft cardboard barrels with more durable, hard plastic barrels for citizens to place their waste for collection. Furthermore, the

[33] The Focus Group number has been withheld to protect the individual's identity.

participant suggested that the 'debate' whether public bins become a *'dumping ground'* can be rectified through infrastructure and service:

> *If we'd go to pick up a bin, if there's trash and stuff around it, we'd clean the trash around the vicinity of the bin itself. So, the complaint that most people have here [in Grenada] that it [public bin] just becomes a dump site, you [can] negate that by cleaning around it as well. (Participant, Focus Group[10])*

In Petite Martinique, I observed that the waste collectors ensured that waste was collected around the public bin, in addition to depositing the materials in the barrels (Field Note, February 19, 2019). Cleaning up around the bins was not observed as the norm in Grenada by contractors, however one participant indicating that contractors will clean up waste scattered by stray dogs (Participant I).

It was clear through conversations with participants, as well as observations in the field, that the removal of concrete public bins has not eliminated people's need (and habit) to *remove waste from the home as soon as it is generated.* Therefore, while the GSWMA spends a lot of time encouraging citizens to adhere to the 'proper' process of setting waste on the day of collection, it is not engrained in the populous, and another 'driver' supersedes this behaviour (GSWMA, 2020a). The habit is understandable, given the tropical environment; it is also perpetuated through the promotion of environmental health and cleanliness of homes (The Grenada Informer, 2013). As a result, people are frequently offloading their waste to communities that still have concrete public bins. Bins are often situated on main roads, like River Road or Grand Anse, adjacent to communities that are only accessible by foot traffic or have roads that are too small for a compactor truck (Participant 7).

> *And so, what you find happening in for example ....people coming from other parts maybe as far as St. Patrick's, St Andrew's as they're driving on their way to work, to school, they stop in low-income community and offload all their garbage into this open receptacle. So not only is there less space for the people in that community to have their garbage, but then it's encouraging the breeding of the rats and so …in that community. And so, the community... they don't feel supported in this whole you know, garbage disposal drive because they feel* ***like garbage is dumped on them****. Instead of, you know, we're trying to help you to have a clean environment. Yeah. That's something that has to be looked at. (Participant, Focus Group A)*

Participants reflected that because there are so few public bins on the island, the existing bins are filled and overflowing long before they are collected by the GSWMA contractors (Participant I, M;

Focus Group C, F). Overflowing public bins were observed almost daily during field work, particularly in areas close to where I was staying and traveling in St. Georges, like River Road and Grand Anse. One hotelier indicated that the state of the public bin in Grand Anse is "upsetting" and "disgusting" on a daily basis; this was especially concerning given the bin's location in the middle of a tourist area (Participant 15). In reference to the River Road public bin, one participant commented *"It's a populated area. That one bin is a joke. That only serves three or four households"* (Focus Group G). As illustrated from the quote above from Focus Group A, eliminating bins in one community unjustly downloads the problem of overflowing waste, stray dogs, and rat infestations on to other communities. Many participants from both interviews and focus groups confirmed that they themselves frequently travel with their waste in their car until they passed by a community bin (Participant F, H; Focus Group B, E, F, G); this same practice was viewed as problematic by others, often in the same focus groups (Focus Group A, B, G). An example conversation about the removal of the bin in Mt. Paranassus in January, 2019[34] is illustrative of the implications of removing bins, as citizens travel with their waste and downloaded on to other communities (Box 6.3). While participants did not necessarily agree on whether waste should be taken to other community bins, it was evident that this habit is engrained with *engaged citizens* that are concerned about waste management; it is expected to be equally, if not more, prevalent amongst people that are less interested or concerned with waste management.

It was evident from my conversations with participants that the GSWMA communicating '*put your waste out on time'* and eliminating public bins was not working. In fact, this messaging was counter to the habits of Grenadians – Grenadians do not like to store waste in their house. The existing public

[34] GSMWA announcement of public bin demolition on January 15, 2012 (https://www.facebook.com/GSWMA/posts/2184240278282167), and field notes indicated a planned GSWMA sensitization event on January 11, 2019.

*Participant G1:* So, you have to hold your garbage with you. So, if you're fortunate and you have a bin alongside your area, you use that. Otherwise, you have to find a bin somewhere else, put it in your vehicle, and transport it down to a bin..."

*Participant G2:* That's another thing, people are leaving their houses and going [with it] ... I watched a man come with his car with rubbish. I was sitting waiting for someone to pick me up in Grand Anse in the park, and this man came with his car. Two bags of rubbish to put in that concrete bin in Grand Anse. It was full to overflowing. You telling me he didn't realize his bag couldn't fit in? He still threw it, and it just fell on the ground and just got back into his car and drove off. But he's not living in the area. I'm sure he came from somewhere else.

*Participant G3:* Well, there is your problem. There's no rules… about rubbish. *'You can't tell me you don't put my rubbish in Camerhogne Park!'* I see people do it. And I know exactly where they came from because I know them. I say, *"You are traveling real far with that rubbish."* …There's nothing stopping you from doing it.

*Participant G2:* But it is overflowing. You can see the bin can't hold anymore. Take it and go, and find somewhere else to put it.

*Participant G1:* The closest one right now to Mount Parnassus …when you pass there, everything is overflowing, everything. So, very soon they might come in and take out that bin…

*Participant G3:* Removing the bin, you know, you are just spreading the problem, compounding a problem. We don't have much vector diseases here and malaria and all of these things. But when people do not throw their garbage properly on their compound, you can have a problem starting right there.

*Participant G2:* Everybody should have their own bin.

*Several participants:* I agree.

Box 6.4 Example conversation related to public bins and travelling with waste (Focus Group G)

bins were overflowing as a result of people looking for the few remaining bins to deposit their waste; waste piles (without bins) were developing in replacement; and waste was still being scattered throughout communities by dogs. Consequently, there is a need to regularize and standardize collection services and infrastructure offered by contractors and establish a clear policy and best practices for the use of bins.

Several participants indicated that once the waste is put out for collection, it is gone *"…it's a problem on their hands"* (Participant A). If, for example, the truck does not come, it just stays there and gets dragged around by the dogs (Participant F, M). One newspaper article described *an out of sight, out of mind philosophy* (Ferguson, 2020). For participants, an ideal waste management system focused on improving the efficiency and effectiveness of collection, which includes access to infrastructure for household waste and urban, in-transit waste.

Many participants indicated that more frequent (daily) pick-ups, like the major towns, or options for dropping waste at a transfer station were desirable (Participants D, E, F, H; Focus Group A, B, C, D, E, F). One expert participant indicated that a transfer station in St. Patrick's had been previously considered, but budget constraints may have limited the development (Participant 17). For one participant, an ideal waste management system included options for residents to have both household pickup, and a transfer station to drop off waste at any time that they like:

> *…you want to give people the options because if I'm coming to Grand Anse and there's a drop off box [public bin] I'll take my stuff….I don't want to leave it there [in the house] (Participant H).*

Based on observations in affluent communities, one participant suggested that every household should be provided a bin to deposit their household waste.

> *A good initiative would be to just ... **supply bins**, you know, partner with the entrepreneurs in and around the urban areas to just get bins as close to every door as possible. And no one would be thinking of trying to steal someone else's bin because everyone has their own. (Participant, Focus Group A)*

If bins were numerous and available, they would not become overflowing or disappear from communities; for example, the participants in a focus group in Grenville indicated that a community group had purchased bins for the town, but they had since disappeared (Focus Group B). It was clear from the participants that *more bins*, not less bins were the solution to overflowing bins, as well as the problem with litter (Section 6.3.1).

### 6.3.4 Comprehensive waste collection

Household waste collection provided by the GSWMA does not collect all waste that is put out on the island. For example, GSWMA contractors are not necessarily responsible or contracted to clean up illegal dumping sites, such as tyres left on the side of the road. One participant indicated frustration with the fact that the contractors did not pick up all waste.

> *… **collection is not comprehensive**… some things that get thrown into the bins by households are collected. But there's other things that are on the roadside that are not discarded tyres, discarded anything and everything, including the old vehicles. So, it's only a portion of waste that's collected. There's no system that I know of that is more inclusive. (Participant, Focus Group G)*

During field work, I observed and record the location for hundreds of derelict vehicles on the island (Appendix 18). I also witnessed firsthand the frustration of citizens trying to get vehicles removed from their neighborhood in San Souci (Figure 6.5). In line with findings from Chapter 4, participants indicated there once was a robust effort to get rid of derelict vehicles around the country, but participants differed as to whether the current state of derelict vehicles was *as bad as before.* Observations and participants indicated that derelict vehicles were beginning to pile up around the island (Focus Group A, B, E, F).

> *Vehicles used to appear to be a bigger problem than they appear to be today, because 25 years ago, the place was strewn with dead cars and absolutely strewn... (Focus Group A)*

> *The amount of derelict vehicles we have an island, I'm sure, is equal or twice the amount of vehicles that are presently on the road and there's no way to get rid of them. They sit by the road, creates a health hazard, mosquitos. They just sit there and nothing has been done to somewhat remove them from those dangerous areas or from communities where you creating a health hazard. And there's no scrap yards here so that we can compress them or cut them up, and send another ship… (Participant, Focus Group B)*

Derelict vehicles present several problems for Grenadian society. For example, one participant indicated that derelict vehicles are causing strain on the road as everyone must pass on one side of the road to get around the vehicle, and this in turn, puts a strain on the economy (Participant, Focus Group E).

Observations indicated that derelict vehicles were 'given notice' to be removed by the owner, but participants felt that there could be more of an effort to remove these vehicles from communities. For example, participants suggested that all derelict vehicles in Grenada should be traced back to the last owner using the VIN number or the license and charge the owners for disposal (Focus Group F). Others expressed concern that there was not an easy answer, and frustrating that they could see a tipping point, but nothing yet was being done.

> *I don't know what the answer is, but I think that there needs to be a response that is regional, unilateral, across the region to deal with this particular situation. And I think like we all see it coming. But it hasn't gotten to a breaking point yet. And so, no one is necessarily doing anything about it. (Participant, Focus Group A)*

This participant further suggested that there could be an environmental levy or tax to discourage the importation or encourage proper recycling of the vehicles (Focus Group A).

Consequently, citizens play a critical role as users of the waste management system. Grenadians - through their everyday habits, decisions, and preferences - generate waste and want to dispose of waste. They may choose to sort their waste, by removing materials, such as biodegradables, and disposing this waste in a different way. Some citizens however choose not to sort their waste due to preferences, past habits, or lack of available infrastructure.

## 6.4 Citizens as stewards for the environment

The study participants demonstrated that they care about waste management, based on their response to advertisements and participation in interviews or focus groups. Predominantly, however, participants thought that the average Grenadian, Grenadian companies, and the Grenadian government *does not care or prioritize* waste management (Participant I, J, K, M; Focus Group B, D). From my conversations, it became evident that there was a need for a national dialogue about waste management in Grenada, even amongst 'engaged citizens'. On several occasions, participants struggled to answer my questions related to an ideal waste management system – it seemed to be something that they had never really thought about or contemplated. For example, one participant and member of an environmental development group suggested that their group had not done enough work on thinking about waste management: *"I don't know if we have ever really thought out what would be the best scenario for good management [of] solid waste"* (Focus Group F). They indicated that this was an important area of work that they need to engage more to lead their parish (Focus Group 6). In other groups, there was clear motivation to continue these conversations about what waste management looked like or was desirable in Grenada (Focus Group G).

> *I think if Grenada opens up to these kinds of conversations, even on a TV programme or something, … it will heighten awareness of some of the challenges and maybe touch people to doing a little bit better, you know, because … waste, it's very seldom talked about, because its waste. But waste is a problem. Waste has a health problem attached to it. I think we need to go out, and the same government as well. We need to educate people about the ills of not doing things, cleaning, composting you know. What can happen to you. People dont... recongnize until it happens to you. You know know. We have people living amongst rats and all kinds of stuff. But if they only know if a rat bite you, you can get really, really ill... (Participant, Focus Group G)*

There was notable frustration amongst participants on the priorities and actions of the government. When it came to environmental issues, one participant indicated that the government was *"walking,*

*but not talking"* (Focus Group G). Several participants indicated that waste management is not a priority issue for the government, but rather their primary concern was tourism (Participant F, M, P):

> *They're mainly focused on tourism. But then, proper waste management ties back to tourism. Because if you have an outbreak of something in the water, it would effect tourism. If our coral reefs are dying from leachate or whatever. It still ties back to tourism…. Or some outbreak of kind of cholera or something. That's still going to affect tourism. (Participant P)*

Several participants indicated that the government is focused on the wrong things in terms of development, waste management and innovation in the country.

> *They focus on just making money. And not the long term…health issues and even this recycling and making our own products, exporting more than we import, they don't think like that. Just concerned about tourism, building hotels and stuff. But the main things we should try to build the island itself… With recycling, we could save money like that [by] exporting our own stuff. They don't. They focus on the wrong place. (Participant F)*

In addition, a number of participants suggested that Grenadians do not really care about or know about the health and environmental implications of poor waste management. For example, one participant, who is Grenadian but was not born in Grenada, indicated that they could not fathom why Grenadians were not protesting the toxicity and health impacts of the fires at Perseverance:

> *I'm wondering whether it's a cultural thing, where rubbish is something that you don't really think of, talk about, it's not really an interesting topic of society. Because if you think that the area where Perseverance … is actually the Prime Minister's [constituency]… This thing has been burning for like years, releasing a level of toxic, that was about like five hundred times higher daily than the lifetime intake that someone should get. …Completely unbelievable, the health effects! But somehow the authority doesn't get the slack for it. …I'm thinking what about the people living there, what about the children being born in those areas. It's just unbelievable. They must have absolutely terrible breathing conditions. But somehow there wasn't any, nothing happened. There wasn't demonstrations in the street about it, there wasn't any articles in the press about it. There was not enough public outcry about like, no one really got upset. (Participant K)*

There is limited reporting on the environmental injustice associated with the burning dumpsite. Out of 235 articles consulted, only 7 referred to the fire at Perseverance, and only three articles reflected on the environmental justice or health concerns of citizens (Ferguson, 2020; Hosten, 2017b; The New Today, 2020). The dumpsite was on fire from 2016-2017 for approximately two years (Straker, 2017), and then again in 2020 (Ferguson, 2020; The New Today, 2020); one author indicated that fires had become an annual challenge (Ferguson, 2020). During field work, I heard about the GSWMA putting out a fire at the dumpsite and observed the tyre pile adjacent to the dumpsite burning (Field Notes, December 19, 2018). There was a notable lack of reporting on the state of the dumpsite; this aligns with findings from Chapter 5, which indicated lack of data collection on environmental and health impacts. One recent article quotes the Opposition Leader suggesting that the Minister of Health *"wants to slight it (burning at Perseverance) as if that is not his business…"* (The New Today, 2020, para. 5). Another article quotes the Minister of Health as being *"very much aware of the situation and … seeking to find ways to ensure that the 'problem is alleviated'"* (Hosten, 2017b). The government does not appear to have been held accountable for the state of Perseverance in past elections, and the public has not demonstrated that the burning dumpsite should be a priority issue.

Several citizens indicated that a politician's primary focus was getting elected (Participant K; Focus Group A, B), but this also puts citizens in a powerful position, in which they can demonstrate environmental stewardship and demand action:

> *… the only thing that interests politician is what will get them elected. That is the only thing that interests them. So, it's... back to the people. People have to start... the fact that so far, no stakeholder really made a big deal about not having a proper [waste management]strategy. Because it's all well and good to have like foreign projects that come in, and that implement something. But there needs to be some* ***kind of willingness locally to absorb those projects and to put them in place****. So, as long as Grenadians do not care about where their garbage goes and how does that impact their environment and their health, then all of that will happen. Because you want that political will to be able to put things in place. (Participant K)*

Engaged citizens, like those who belong to community groups and wanted to talk about waste management, are in positions to lead ground-up initiatives that support waste management in Grenada (Focus Group F). While a few participants indicated that it 'needs to come from the top' and that politicians *have to lead* (Focus Group A), other participant suggested that citizens should *not wait for government, and lead by example and conversation* (Focus Group G).

Participants suggested that the only time things get done in Grenada is if there is economic incentive for environmental initiatives. This often means that there is funding available through external funders, like the Green Climate Fund. Two participants indicated that the Non-Biodegradable Waste Control Act was passed to access funding (Participant N; Focus Group B). This aligns with findings in Chapter 5, which noted the government's focus on climate change funding (Participant 26). Cynically, one group indicated that if there was no external funding, they believed their government would not be acting on these issues (Focus Group 2). Another participant reflected that the Non-Biodegradable Waste Control Act was progress, but it cannot be the *only* thing that gets done for the environment:

> *<u>But that was last year.</u> What else are you going to put in? Because saying no to Styrofoam is one thing, but what else? Because that's not the only issue we having... (Participant D)*

Citizens have a role to play as voters and as stewards of the environment, if they are given the opportunity and have the capacity to do so. In the following sections, the results are presented for three challenges in terms of the disposal of waste: concerns about the littering, dumping and the state of the dumpsites. Box 6.4 contains a description of how I differntiated littering and dumping in this dissertation. Participants suggested a number of means of deterring improper dispsosal, such as education, implementation and enforcment of laws and community, civic pride. The results are summarised in Table 6.2.

**Littering** describes an act of dropping or leaving waste while 'on the go' (e.g., traveling between their residence, work and other locations), or while engaged in recreation (e.g., at the beach). Littering is an act committed by individuals or small groups, and it occurs with a small number of items at any one time; these items are generally personal use, like food wrappers, and can be cleaned up by individuals (e.g., government officials, volunteers). Littering can be either intentional or unintentional but can be ameliorated by placing waste in a collection receptacle (either public or private).

**Dumping** is an intentional act of dropping larger amounts of waste (e.g., a bag of household garbage, a truck load of electronic goods) and/or large items of waste (e.g., a washing machine) at a particular location. Dumping is an act committed by individuals, households, companies or organizations as a means of getting rid of waste while ignoring legal channels of disposal. Dumping can be ameliorated by transporting the waste to the allocated disposal site.

While both existing littering and dumping sites can benefit from voluntary and institutionalized clean-ups, dumping sites usually require professionals with capabilities to lift and transport a large number of items. For example, cleaning up areas like Mount Hartman and Windsor (Figure 6.6) is beyond the scope of a volunteer-led weekend clean-ups prevalent in Grenada.

Box 6.6 Definitions of littering and dumping

| Main finding: | Number of participants: | Participant sample quote: |
|---|---|---|
| Littering is a problem; littering is cultural or engrained habit, but also there is a lack of bins in public spaces for people to throw waste. People litter due to lack of awareness and education, lack of care, and they think that by littering they are creating jobs. | Participants: D, I, M, N, Q, R, S<br><br>Focus groups: B, C, D, F, G | "Many times. I am the person, if I go outside with my friends, and we're at a street party, or Carnival or something like that. And they would look at me because they want to drop their bottles and I would be the one who picks up the bottles and goes and bring it by the vendor. And yes, they would tell me I'm crazy." (Participant D) |
| Commercial businesses do not take responsibility for their waste. Businesses use curbside pick-up, despite not paying for it. Commercial businesses also dump waste instead of taking it to the dumpsite, impacting communities. Finally, commercial businesses need to take responsibility for the waste generated from their products (Extended Producer Responsibility). | Participants: B, D, H, I, K, P, Q, R<br><br>Focus groups: A, B, C, D, F, G | "The private trucks are …dumping it in Savon Swazyee and other places, so I don't want to do that. So that's a problem. If you don't get the regular public system, you don't have trust in some of the small private [contractors]" (Focus Group F)<br><br>"I think if you're bringing in the waste, if you're creating the waste, then part of your responsibility is finding that way to fix it. So, I know in certain countries in the world where people can take bottles or jars into a machine. …" (Participant Q) |
| Education is a means of challenging littering habits, and the assumption that littering creates jobs. Educating children because adults are set in their ways. But children can teach their parents. People need to be told *why* not to litter, and the implications of their actions. | Participants: A, D, G, H, I, J, M, N, P, Q, R<br><br>All focus groups | "Before we used to look at adults teaching children, but maybe we have to look at the children teaching the adults. Work through the children in our community environmental groups, work through them. So, if they see it, you might, chances that their conscious... they say "Mommy, don't throw it outside. It's not good for the environment. Look it...Miss. said so." (Focus Groups D)<br><br>"I think that's a difference with telling people 'Okay, don't litter, don't throw this down.' And, then tell them *why* they shouldn't" (Participant D) |
| Implementation and enforcement of the legislation including the Waste Management Act and Litter Abatement Act. This requires political will, accountability, and training of litter wardens. | Participants: I, N, P<br><br>Focus groups: A, B, E, F, G | "I think there is a tremendous environmental ignorance that needs to be combated. And in the last few weeks, I've heard from many sources, it has to come from the top, politicians have to take a lead. Ours [politicians] don't... And that is reprehensibly sad. I don't think they seem to understand the issues themselves or they are so afraid that by taking any measures, they will lose votes." (Focus Group A) |

| | | |
|---|---|---|
| Clean-ups are widely practiced; but there is frustration with the need for clean-ups. Community and civic pride, drawing the connection between keeping house and yard clean, and treating the country as it is your backyard. | Participants: A, B, D, H, J<br><br>Focus groups: B, C, D, G | "Grenadians are very, very particular about keeping their yard clean. So, if you could remind them, you wouldn't do that in your yard, why do it? You know, isn't Grenada yours? All of Grenada is yours. If you could draw the link…" (Focus Group D)<br><br>"If you go to anyone in Grenada house, it is not dirty, it is not littered. Very few people have litter around their immediate house, so then why do it?" (Participant 15) |
| Concern about the state of the dumpsites, including leaking of materials into the soil, water and surrounding environment, fires, and health concerns with the surrounding communities. The dumpsite is lacking space and at capacity. | Participants: A, B, D, F, G, H, I, J, K, M, P<br>Focus groups: B, C, E, F, G | "There's just more and more build up and we're just gonna end up one big garbage heap of an island if we don't do something because there's nowhere else where to go. They just keep piling and piling and piling and hoping that ... it will just disappear on its own." (Participant M) |

Table 6.2 Main findings of citizens as environmental stewards

### 6.4.1 Littering of waste by citizens

In an ideal waste management system, waste is disposed in a manner that does not harm the environment (Participant G; Focus Group A, D). Litter and the habit of littering was identified as a key challenge for waste management in Grenada (Participants D, I, M, N, Q, R, S; Focus Group B, C, D, F, G) and observations indicated that littering is a recurrent disposal method for many citizens. As all the major towns in Grenada, Carriacou and Petite Martinique are adjacent to the ocean, littering in the drains flows into the sea (Focus Group D, G).

In a newspaper article, an author reflected on the state of Bathway Beach after the Easter holiday and lamented over how society should respond to this situation.

> … *These wreckers who have destroyed the lives and livelihoods of residents, tradespeople, and the tourism industry, have left without care period secure, no doubt that some band of do-gooders will clean up so that they can return to despoil the beach another day.* ***How should we, as a society, respond?*** *(Super User, 2014)*

A similar story was reported by the focus group participants in St. Patrick's. Bathway Beach is a popular 'fete' spot for Easter and Independence Day (Grenada Green Group, 2017a). After a holiday, "every square foot" was covered in litter, and so the community group started handing out bags to groups and increased the number of bins at the beach (Focus Group F).

Participants reflected on their shared experience of driving behind a car or bus and witnessing someone tossing litter out of the window (Participants D, M, Q, R; Focus Group D; also, Participant 25). On route to Grand Anse, I observed a bus conductor tossing a glass bottle out of the window as the bus rounded the corner out of the Carenage in St. Georges. Bus passengers and bus drivers can also play a major role in developing the consciousness of Grenadians. One participant told a story of being on a bus, and a passenger flinging a bottle out the door when the bus was stopped. The conductor got out of their seat, picked up the bottle and put it in the bin in the bus. This action demonstrated environmental consciousness to people on the bus.

> *Just him doing that. Everybody on the bus was conscious, whether they were conscious before or not. And felt really ashamed for the [person] (Focus Group D).*

Another participant suggested that bus drivers can play a role in letting people know to not throw litter out the window and by providing a bin to collect rubbish on the bus (Focus Group F). A

development group in St. Patrick's had planned to develop an award for "litter-free" buses, but they had not yet planned how this award system could be implemented at the time of field work (Focus Group F).

> *[As a bus driver] all you've got to say…when you have a full bus: 'This is a litter free bus. We don't want you throwing things out of the bus, we've got a bag on the bus. If you've got any litter when you're leaving the bus, we'll collect it. (Participant, Focus Group F)*

The organization indicated that this idea did not come from their members, *it came from the people on the ground* that they'd surveyed and talked to as part of their long-term planning as an organization.

> *So, people are aware of what should happen. And this came out of people in the ground and the community saying this is what we should do. So much more of that [type] of interaction should help solve… (Participant, Focus Group F)*

Participants indicated that a local development organization has had a lot of success in developing anti-litter campaigns and generating awareness about littering in their community; participants were encouraged by this approach. *"…campaigns. Much more campaigns. Community campaigns, I think that's where the answer lies"* (Focus Group F). Examples completed by the development organization included campaigns in communities 'upstream' to prevent littering on the beach at the source and installing billboards stating "Thank-you for not littering" as patrons exit the beach. Consequently, numerous participants that strongly felt that community interaction, community-based campaigns and talking to community members was a way to engage and motivate societal change (Focus Group F).

> *So, it's the little campaign because at the end of the day, Grenada don't have money. Funding is … very hard. So, if it is solid waste, and everybody kind of gets into a campaign, the litter warden, I think … people become much more conscious because we small,* ***we have the advantage of being small*** *… and we could win. But people have to see it as part of their personal journey. To be, you know, to be litter, litter free. So, it's a big campaign. I think that's where the answer lies more than investment in [infrastructure, technology][35]." (Participant, Focus Group F)*

[35] The participant indicated that one caveat to this statement is that the area of the focus group needs more trucks to meet the needs of the community (Focus Group F)

This aligns with another participants perspective that a focus on big projects cannot and should not be the only way forward for Grenada (Participant B), and that there needs to be a broader conversation nationally about waste (Focus Group G).

When asked why people litter, participants suggested a range of reasons. One participant suggested that people do not consider the impacts of both littering and dumping:

> *But then I don't think a lot of people also think about the effects it's having on like the ocean and that type of thing. All they know they got rid of it from their standpoint, so their problem has been solved. And not considering the problem …they've created for the rest of the [country] (Participant D).*

This aligned with another participants observation that people are absent-minded and simply lack awareness; instead of considering carrying a waste item, when it is no longer needed, it's better to just drop it (Participant R). Some suggested that littering waste is a cultural practice for some Grenadians (Participant D; Focus Group B). One of the explanations offered is that *"right now, we are in a system in which people don't really care."* (Participant, Focus Group B). One author of a newspaper editorial was perplexed on why Grenadians could not keep their surroundings clean to prevent the spread of mosquito-borne diseases *"…sometimes I am at wits end to understand what the heck is wrong with us."* (Peters, 2016, para. 4)

Clean-ups are positive, as they prevent litter from getting into the sea. But participants indicated that they would hope that people engaging in clean-ups are also engaged in education to prevent littering in the first place (Focus Group D).

> *More effort is made to prevent the quantity of garbage - that's reducing- and, the disposal, particularly the irresponsible disposal of garbage. So, it boils down to the education. (Focus Group D).*

### 6.4.2 Illegal dumping by companies and citizens

The dumping of construction and commercial waste was a poignant problem for participants. One participant indicated that the government needs to start enforcing environmental laws as companies just *"do whatever they want to do"* (Participant K). While companies do not pay a tipping fee to dispose of waste at Perseverance or Dumfries (Chapter 3), it is cheaper still to dump waste than to truck it to the dumpsites. One participant described a situation when they witnessed a truck dumping

construction waste in Calliste, an area close to the airport and St. George's University. The participant indicated that the dumpers made *"no effort to hide what they were doing"* – in other words, boldly committing illegal acts; yet, when the participant called the police, they took down some information on the phone but never showed up at the site (Focus Group B).

Newspaper articles indicated that construction companies and subcontractors dump their leftover cement in natural areas (Grenada Green Group, 2018; Kawana Bay Resort, 2020). Observations confirmed a number of concrete dumping areas, including a large site in the True Blue area which is frequented as a waste-cement dumping ground, according to a citizen (Field Notes, April 6, 2019). One newspaper article reported that a citizen was threatened when they were taking pictures of trucks dumping concrete in their neighbourhood (Grenada Green Group, 2018). The Mount Hartman estate, an important nature reserve and habitat for the endemic Grenadian dove, has become a dumping ground for construction waste (Participant K)[36], confirmed by observations (Figure 6.6A; Field Notes, April 12, 2019).

Illegal dumping is exacerbated by events, such as Hurricane Ivan (Focus Group B) and challenges with infrastructure, like the recent Molinere road closures (Campbell, 2020). Furthermore, when the Perseverance dumpsite was on fire in 2016, the GSWMA paused disposal of tyres at the temporary dumpsite to conserve space (Straker, 2016). Conversations with citizens in Carriacou indicated that the road to the Dumfries dumpsite frequently floods, and therefore trucks do not drive all the way into the site for fear of getting stuck. All of these events provide barriers to waste making it fully to the dumpsites.

Illegal dumping occurs from both small businesses and large manufacturers in the country. The prevalence of dumping in the country made one participant hesitant to hire a small, private truck to collect their white goods and large household waste; they do not trust private contractors to deliver the waste to Perseverance (Focus Group F). Participants indicated that a major food manufacturer was dumping waste in a community on the eastern side of Grenada for a long time. Recently, however, the community stood up for itself and began turning the truck away. One participant described the situation leading up to the incident:

> *When we were doing the cleanup of the coastlines, moving all the big, big dumping from the two [communities], we had done some work with the with [community] and shortly after this I think*

[36] Additional sources from Flow news (https://www.facebook.com/watch/?v=799035740260286)

> *it was [local food producer] came up with a truck to dump their stuff* ***and the [community] people tell them NO.*** *(Focus Group F)*[37]

The participants indicated that this was an example of a community standing up to a large company and telling them that they cannot continue to dump waste in their homes. When I asked, however, *where does the [large food manufacturer] dump their waste now?* Participants indicated that *they probably go to Pearls*. The Pearls Airstrip is the former airstrip that is now used for recreation, like Drag Racing (Grenada Green Group, 2016a). Observations indicated that Pearls Airstrip is strewn with dumping, construction waste, motor oil waste and litter (Field notes, April 15, 2019). This idea that communities can and should stick up for themselves was reinforced in another focus groups, with one participant suggesting that a solution to dumping is 'good, old Community watch'.

> *[an area in St. George parish was a] dumping ground for decades, and eventually they developed a community watch, and people say 'Hey! where you passing going with that muck?' [And they] send them back with it. Community watch - it works. (Participant, Focus Group G)*

Newspaper articles also indicated that dumping, especially from companies and subcontractors, continues to be a problem on the island; editorials written by the Grenada Green Group (G3), demonstrated that communities are frustrated with dumping. One article quoted a resident in Savon Swayze:

> *…it just seems that as usual, people just took advantage of the situation to make money collecting rubbish and to avoid spending the time and money to dispose of it effectively, namely at the Perseverance dump. (Grenada Green Group, 2016b)*

[37] Names of communities and company withheld for confidentiality.

Figure 6.5 Extensive dump sites
A) Mt. Hartman, April 12, 2019, B) Windsor, April 8, 2019

### 6.4.3 Concern with the state of the dumpsites

For participants, an ideal waste management system offered a more environmentally friendly way to dispose of waste.

> *Disposal preferably in some form that is harmless to the environment of which we are a component. I refuse to think of the environment is something out there. (Participant, Focus Group A)*

The co-mingled nature of waste in Grenada was described by one participant as a "soup of rubbish" with all waste just "mixed into Perseverance" (Participant P). Almost all the participants indicated that a major challenge of waste management in Grenada is the state of the Perseverance and Dumfries dumpsites, and the sheer accumulation of materials.

> *We are not properly disposing of our garbage. Even little things, as I said, that can be used. Some of us don't know how exactly they can be used. So, we just throw it away. And eventually it just sit[s] there. (Participant G)*

One participant noted that improvements of collection since the formalization of waste management in Grenada but noted that there have been no improvements in the disposal of the garbage. *"We have improved in gathering it. I'm not sure about disposing it."* (Participant, Focus Group G). Descriptions of Perseverance in grey literature from the 1980s and 1990s (Chapter 5) aligned with my own observations of both the Dumfries and Perseverance dumpsite *(*Field notes, December 19, 2018; February 14 & 15, 2019). The dumpsites in Grenada and Carriacou were described with disgust by many participants:

> *No tourists coming to our island to see this mountain of garbage there. It's very unsightly. (Participant, Focus Group E)*
>
> *The dumpsite is sickening. (Participant A)*
>
> *Carriacou is in a terrible state in terms of their landfill. (Participant, Focus Group B).*
>
> *There is the environment levy that compels all of us to pay for disposal of waste if we use certain amount of kilowatts [of electricity] and then it has* ***not been properly managed properly, properly done****. (Participant, Focus Group B)*

One participant described the burning at the dumpsite as a coal pit, burning from within.

*If you look at Perseverance, you get all the answers you want to know. Everything is in one big pile. And some years ago, I'm not sure if it was unintentional or planned,* ***Perseverance was lit*** *[i.e., fire].* ***Perseverance burned …about seven years? It was smoking. It was like what we call a coal pit****. We make our own coals in Grenada for cooking. You chop down trees and you put it in earthen. It's not really a hole, it's something you dig out and then you cover it and you burn your own coals. So, Perseverance became like a coal pit. It was burning from below for many years until eventually [went out]… that took a long, long time. (Participant, Focus Group 7)*

Participants described the strategies that they used to avoid breathing in the air when passing Perseverance: holding their breath, covering their mouth and nose with a cloth, or rolling up the windows well in advance of the site and turning on the air conditioning (Participant B, G). Burning was viewed as a major threat to environmental health, and there was significant frustration over the appearance that nothing was being done to prevent it from happening (Participant G, K)

*They will just burn it, and it will just be building, and building up, and building up, and nothing is done with it ... (Participant G)*

The state of the dumpsite is of environmental justice concern, especially for the surrounding communities; one newspaper articulated this injustice:

*One appreciates the challenge facing the Grenada Solid Waste Management Authority. However, it is unfair and unacceptable that the citizens of the surrounding communities should have to endure exposure to this level of pollution for such an extended. One hopes that the citizens being affected by the landfill fire could be brought some relief soon. What would be the response if this situation affected Happy Hill proper or another community in the South? (Ferguson, 2020)*

*Another expert participant expressed concern for the people living in the area of Perseverance:*

*I am telling my children when we pass to not breathe. It must be cancerous... Is there any information on that smoke, how dangerous it is for people in that area? And how far the toxins [travel]…is it going up in the air, or if the wind is blowing this way, are people in Grand Anse [breathing it in]. If I lived in the area, could I sue the government? (Participant 15)*

One participant described a particular moment that was meaningful in their own individual journey after observing school of dolphins heading for Halifax Harbor (the bay beside the Perseverance dumpsite).

> *I was staying at Mango Bay, and we saw a school of dolphins who were going into the bay. And I was like that's garbage it's not good for them… I think 2014 was the year that I decided that the littlest amount of garbage I could possibly send there would be important to me. So, I think that would have been the year that I decided these are the things I need to [do]…. Because they were heading right into the bay. And then you're thinking, every single chemical, anything that could possibly harm them, is going to be there swimming in. And I think that one [the situation] got to me. Because all of us, were like so excited. There was a group of us. We were so excited that we saw this school of dolphins. And then it's like, well, wait a minute. They are heading for Perseverance. So then, you know that type of reality, the juxtaposition of the excitement with the fact that we're heading towards waste, that got to me. (Participant D)*

A focus group participant indicated that Perseverance is not an ideal disposal site for garbage due to its proximity of the sea; they thought the area was quite polluted and had noticed black water and dead trees in the area (Focus Group D). Another participant expressed concern that Perseverance was not a sanitary landfill and that "everything goes into the bay" (Participant P). A focus group participant expressed concern about the growth of the Perseverance dumpsite, and wondered how much it would have to expand to accommodate future waste practices (Focus Group D)

> *...coming up from St. George's on the left side of the road. And then they went onto the right side near to where the scale and so. They went down, they dug down ... that got filled up. So, they came back over there and they are topping it up higher. And then they also have a bit on the right side where 'Greens', and 'Protein Waste' thing is there. They have tyres there... I mean, I don't have any calculation or scientific thing on it, but I do believe in next 40, 50 years, Perseverance would have expanded beyond, much further beyond. (Participant, Focus Group D)*

Participants knew that Perseverance was at capacity, and this it was particularly tragic that they were going to have to start looking for a new spot (Participant B, J). Investigations into another location for a landfill, however, have been unsuccessful (Chapter 5). One concerned citizen had been involved with the GSWMA at its inception in 1995. They commented that there had been a lot of good ideas and hopes for solid waste management at the time, including having separation at the

Perseverance dumpsite, but those initiatives had not been realized (Participant R). Due to lack of space, several participants pointed out the necessity to divert materials as Perseverance was at capacity.

> *We depend on the land because our method of waste control is disposing of, dumping. Everything is dumped. There's no sorting, there's no recycling. So, it is dump.* ***Find space to dump.*** *Perseverance is overloaded, and it is difficult to identify a new dumpsite. So, they have to come up with some sort of recycling. (Participant, Focus Group D).*

One participant was surprised that the general populous was not getting upset about the state of Perseverance and indicated that this was likely why the GSWMA seems to operate without a strategy or pathway to improving the state of the dumpsite. *"No one cares. So, that's why we don't have a strategy. We don't have a system" (*Participant K). Due to disgust with the site, for a number of participants, an ideal waste management system included a disposal site that was not seen from the road (Focus Group E), or a site that was enclosed with a barrier to prevent people from seeing and smelling the waste when they pass by (Participant G).

### 6.4.4 Education and awareness

For participants, education plays a significant role in empowering communities to stand up for themselves and say 'No!' to dumping (Focus Group F). The participants felt that when you engage the community and work with the communities directly, promising gains can be made.

> *I think the era of throwing cars in the sea and dumping things in the sea, I think that has been held up a lot. I don't see the dumping much of it in Savon Swazey now, where they used to be everything. There is less dumping. Even in River Antoine, because people have been vigilant and say you can't dump here, so I think that the dumping is reduced because they used to dump it and burn it (Participant, Focus Group E)*

Participants viewed education as a primary means of deterring littering and promoting better waste management amongst citizens (Participant A, D, G, H, I, J, N, P, Q, R; All focus groups). Several participants indicated that there is the perception from people that littering creates jobs (Participant D, I, M N; Focus Group D), and this was confirmed through several newspaper articles (Grenada Green Group, 2017b, 2016c, 2014; Noel, 2014), as well as conversations with experts (Participant 8, 19).

> *This is where education could possibly help because I've had several people [say], when I have [asked] why don't you carry your garbage home or put it in a bin, or something.* ***If I don't do that, how will the street cleaners get work?...If I keep taking away my garbage, how will they get work?*** *(Participant, Focus Group D).*

One newspaper article told a story where parents and adult chaperones of a cross-country race for school children told solid waste workers *"We creating work for you"* when the workers pointed out to the adults that the race participants were littering their beverage containers (Noel, 2014); this story was also reflected upon by a participant in my study (Participant M). Another participant indicated that a similar experience:

> *… I see a child and I say, hey, you shouldn't have put that on the ground … And then the adult, they would say "How would somebody get a job if they don't throw it down?". It's counterproductive… In other words, …how would the road worker or somebody gets the job? So, then you're telling the child, it's okay to do that. (Participant D)*

When I asked the above participant if this is a common perspective, they indicated as a teacher, *"I've heard it many times."* (Participant D). Participants indicated that they hope education could change this perception that littering creates jobs (Focus Group 4). Throughout my conversations, citizens reflected on their own personal responsibility to carry waste home or find a bin, and a commitment to not litter that they wished others would follow. In order to foster this commitment, participants indicated the people need to be told *why* and be informed of the implications of their actions. One participant gave an illustrative example of the power of the *why:*

> *I think that's a difference with telling people… "Don't litter, don't throw this down". And then tell them <u>why</u> they shouldn't do it. It was the last years, somebody from NAWASA, I think was water week or something like that. And he was letting them [the students] know that a simple thing like your sweet drink or your Coke bottle cover [the lid], that's all the water that a mosquito needs in order to breed…Because when I went back to my class, I am Form 5 [grade level], they didn't know it was that simple. Simple things like the 'Why?'. Don't just 'Don't Litter', 'Don't...'…* ***Why don't litter?*** *Those are things I think we need to address as well. (Participant E)*

The importance of *why* is evident in another participants sentiment, of which they believe that people cannot possibly know *why,* otherwise they wouldn't litter.

> *...I cannot, I would not like to think that somebody knows that could have those negative consequences and still do it. …Then the reefs , the value of the reefs as most of these things end up on the reefs, besides damaging the fish and so. And it's dangerous because if they kill off the reefs, the buffer for us, for our coastline (Participant, Focus Group D).*

There was a clear theme amongst participants that education and increasing awareness was an important first step in addressing the litter problem.

> *People have to understand the importance of proper management … it's a mindset you have to want to do it for yourself, in order for it to change. (Participant P).*

One participant (Focus Group G) asked her fellow participants in the group if they had also sung a nursery rhyme in school about littering. In unison, almost instantaneously, everyone else in the room joined her in singing the song 'Bits of paper' (Box 6.5). It was clear that this nursery rhyme had stayed with the participants their entire lives. One participant indicated *"…Even now if you see a piece of paper, you pick it up."*

*"Bits of paper, bits of paper;*
*lying on the floor, lying on the floor;*
*make the place look tidy, make the place look tidy;*
*pick them up, pick them up"*

Box 6.8 "Bits of paper" nursery rhythm

One participant reflected that they thought that the GSWMA was doing a satisfactory job with the resources that they had, but they could use more human resources to get the message out, implement programs in schools and public education. The participant indicated that the complexity of waste management means that more people are needed to do an adequate job of *getting the message out* (Participant, Focus Group A).

To make education on waste management effective, a number of participants indicated that waste management, including sorting waste, needs to be integrated into the school curriculum (Focus Group B, C; Participant 25). The value of educating young people is that they are amenable to change, and may have an influence on their parents' behaviors:

> *Sometimes when young children do stuff in the school, they practice it at home. So maybe the school system should come up with some system [of sorting waste]. And when they go home "Mommy, no. You have to do this like that… (Participant, Focus Group B).*

While the Grenada Green Group had doing school presentations, participants indicated that it needed to be a school initiative driven by the Ministry of Education – in other words, built into the curriculum.

### 6.4.5 Enforcement

For several participants, Grenada does not need new legislation; rather, the government needs to enforce existing legislation (Focus Group A, B). This finding aligned with perspectives from experts involved in waste management, presented in the results from Chapter 5, as well as findings from the material accounts in Chapter 4. For an ideal waste management system to be realized, participants indicated that legislation needs to be implemented and enforced, and citizens need to be educated on the legislation guiding waste management (Participant I, N, P; Focus group A, B, E, F, G).

> *I think directly address enforcement of existing laws that are perfectly good but are ignored. So, laws are one thing, enforcing them is another. And we have some reasonable ones. (Participant, Focus Group A)*

For many participants, Grenada has sound waste management legislation – it is just not enforced, and this was notably frustrating amongst participants:

> *another part of an ideal waste management system would be enforcement of existing legislation, not necessarily new legislation. But just enforcement, because walking [here], I passed a few stores that had their boxes outside their stores….But under the Litter Act, that is littering but nobody's going to them and writing them a fine. (Participant, Focus Group B)*

> *You know, everyone can see where the where the law is being broken, where things are being dumped. We have the infestation of rats and rodents on the sides of the street where the kids are playing, at the beach. Just enforce the law. Don't have the laws on the books that are as comprehensive [instead]* ***figure out a way to enforce it.*** *(Participant, Focus Group A)*

For example, participants suggested that there is a need to hold companies accountable for their waste and motivate adequate disposal provisions (Focus group A). There was desire for both a *carrot* and *stick* approach, in which companies would be motivated to develop waste management infrastructure, such as branded bins outside their shop (Participant R; Focus Group G), as well as be required to develop waste management provisions, as per the Waste Management Act (Chapter 5), and take their waste to the dumpsite (Participant B, D, H, I; Focus Group A, C, F). The participants

suggested to me that the GSWMA should examine their entry statistics to see if 'big' companies on the island (who are generating waste, without a doubt) are bringing waste to Perseverance (Focus Group F). If they are not entering the dumpsite – the only legal dumping location – *then where are they dumping their waste?*

Some participants were aware that commercial operations do not pay for waste management services: *"We pay for [name of manufacturer]"* – the irony that companies do not pay for waste management services and then also have audacity to not even bother taking it to Perseverance was not lost on the participants (Focus Group F).

Furthermore, the Grenada Green Group, as well as participants in this study indicated that a receipt system from Perseverance indicating delivery of the products would be helpful for individuals to know whether they should pay their subcontractors.

> *"[…] have been arguing for receipt system at Perseverance...So, a contractor required to take building materials to Perseverance, who just drive a couple of miles and then dump it anywhere, do not get paid until and unless they have produced a receipt from Perseverance to say that they have taken the load there. Now that would be legislation to have authorized dumps issue a receipt" (Focus Group A)*

Based on observations and conversations with participants, it is evident that the collection services offered by the GSWMA's private contractors are strained in areas of the island. One of the reasons suggested is that commercial entities are making use of public bins and household waste collection for their business garbage. Under the Waste Management Act, commercial entities are responsible for to delivering their waste to the dumpsite (Chapter 5); this practice, however, is not widely practiced or enforced (Participant R; Focus Group B). Participants suggested that businesses were *littering* by putting out their commercial waste for curbside pick-up. In Grenville, for example, only three businesses pay for a subcontractor to take their waste to Perseverance (Participant R; Focus Group B). Consequently, every night the streets of Grenville are littered with bags of commercial waste and overflowing bins (Focus Group B). This is also the case in Carriacou and Petite Martinique where a waste management professional indicated that almost all businesses put their waste out for public collection (Field Notes, February 19, 2019), instead of taking their waste to Dumfries themselves.

> *"The business places will put their garbage just in front of the door. [Instead]…they would need to get proper disposal. Either they would need to bring it to the dump themselves or have a special place where they can throw it in a bin" (Focus Group A)*

Many participants assumed that commercial entities paid for waste management services on their electricity bill, like households; they were often shocked or expressed disbelief when learning from me that commercial entities were not paying their fair share for waste management services (Focus Group C; Participant H).

> *That's ridiculous … there are many instances that I think the government of Grenada are letting money slip through the hands (Participant H).*

Participants suggested that commercial operations need to work together to pay a truck to take their waste away (Focus Group C). The frustration with commercial operations was further amplified when participants learned that commercial entities, when delivering their waste to Perseverance, did not pay a tipping fee (Participant K). For many participants, it was problematic that commercial entities were not paying their fair share for waste management services, and by law, should not be straining existing household collection services. This is further problematized when commercial entities choose to dump their waste within communities or in nature, instead of paying for trucking to the dumpsite.

There was a further desire to hold companies that imported waste responsible (i.e., Extended Producer Responsibility, or EPR). Grenada does not currently have EPR provisions, but a number of participants indicated a desire to hold beverage companies accountable for their bottle generation (Participant P, Q).

> *"The producers would have to consider, like, what would be the end part of my bottle? Like they don't consider that, they just make it, sell it, if they considered that, then maybe we could have a circular economy." (Participant P)*

> *"I think if you're bringing in the waste, if you're creating the waste, then part of your responsibility is finding that way to fix it." (Participant Q)*

There are several calls to 'stop the drop' (Grenada Green Group, 2016d), that is, curtailing the habit of littering and dumping. Many participants emphasized the importance of the government

implementing and enforcing the Litter Abatement Act of 2015 (Focus Group A, F) as a critical to preventing littering in Grenada:

> *... They've got the laws out there; they're just not enforcing it. And I think as soon as they start … the first person that ends up in court for littering, it's going to stop. (Participant, Focus Group F)*

> *another part of an ideal waste management system would be enforcement of existing legislation, not necessarily new legislation. But just enforcement because walking here I passed a few stores that had their boxes outside of their stores... but under the litter act, that is littering but nobody's going to them and writing them a fine (Participant, Focus Group B)*

> *Legislation is not enforced. It is there. But nobody takes any notice of it. (Focus Group A).*

This means that government needs to be willing to enforce legislation; some participants felt that legislation was not enforced because it would impact elections. For example, participants indicated that some business put out excessive amounts of waste, but legislation was not enforced to compel them to make their own arrangements to take waste to the dump site. Participants indicated that the legislation is not enforced due to the political leanings of the businesses (Focus Group B).

> *…Before the litter laws was for big corporations, so the fine was $2,000 and whatever it is, but now the new litter law is a small fine. So, you could enforce it, but it's still not been done. (Participant, Focus Group F)*

Issues of political will were also mentioned by other participants. One participant described the government having *"political un-will"* to act on waste management and environmental issues (Participant K). One illustrative example, one focus group participant indicated that businesses in Grenville were not required to take their waste directly to Perseverance because laws were not enforced due to political leanings:

> *...what you find is that those businesses are aligned with the government. So, he's like, I don't want to impose any sanctions or fee on my friend or my people, for fear of getting on the other side and probably losing some popularity in the next election cycle. (Participant, Focus Group B)*

One participant drew attention to the challenges of political will and politicians doing something that may impact their election. For example, laws like the Non-Biodegradable Waste Control Act could be viewed as limiting people's freedom of choice:

> *"'You're trying to stifle me', that type of thing. Because these things can really affect elections. It's a small country, small constituencies. People get disgruntled about something. It can affect... you're [politicians] thinking about your next four years. So, some people don't want to tackle things at certain times for those types of reasons." (Participant D)*

Another participant suggested that it is not just enforcement of the law, but also communicating to increase the awareness of the laws, as some people are not able to read or choose not the read the law (Focus Group A). Other participants indicated that it would be useful to do an advertisement to show people how to properly dispose of waste.

Another participant suggested that conditions from development agencies, like the Green Climate Fund, would motivate the government to enforce the law:

> *"If the Green Fund said, we need to change the with waste management system, the policymakers will enforce the law. So, you get, we get the funding on these conditions. Things will start working. So, if if your country does not have a proper waste system, you are not doing recycling....sorry, you can only get 2%. If you have a proper system, enforce all the laws, you get 100%. Regular monitoring and evaluated [outcomes]"(Participant, Focus Group B)*

Participants were frustrated with the fact that they were not yet seeing Traffic Wardens bring used as litter wardens under the legislation (Government of Grenada, 2018c), and calls to implement the act were widely documented in the newspaper articles. One participant indicated that a challenge with enforcing the Abatement of Litter Act with litter wardens is that in a small community, small island, *everyone knows each other.*

> *"Now if I'm an anti-litter warden …and I see my neighbour littering, am I going to charge or arrest? Or my uncle or my aunt? … because with policing, … they think it's okay to put police that come from a village in that village. Big problem. So, it's not very effective." (Participant, Focus Group F).*

### 6.4.6 Infrastructure

There is a lack of public infrastructure to support proper waste management activities in Grenada (Participant R; Focus Group A, B, C). Several participants indicated that there is lack of public bins in high traffic, urban spaces like St. George's, Grand Anse, Gouyave and Grenville resulted in people not having places to put their waste (Focus Group A, B, C, D).

> *"There's just no public bins. Like you walk down the street, and you never see a trash can anywhere" (Participant in Focus Group C).*

Observations confirmed that there are limited public trash receptacles for 'on-the-go' waste disposal, resulting in frequent littering. In a focus group in Grenville, participants indicated that a development group had worked with the Grenada Green Group (G3) to get 10 bins to put around the town of Grenville to collect public waste. The bins had since 'disappeared', and people did not know what happened to them. Furthermore, one participant indicated that they had called the Ministry of Health to see if they could put bins along Grand Etang road for, but public servant indicated that they did not want bins along the road as it would encourage people to dump their waste (Focus Group B).

While participants were interested in having more public waste receptables, they were skeptical if the receptables would get properly used. *"Even if there is plastic bins there, they still dump around the bins"* (Participant, Focus Group B) (Figure 6.7).

> *"People don't need bins to dump [throw out] their waste because… there is an unsightly dump just by the market [Grenville]. There's no bin there. But people just dump things there. Small things, KFC boxes" (Participant, Focus Group B)*

Litter clean-ups are quite common in Grenada, and they are organized and run by a variety of non-for-profit organizations, like CYEN and the Grenada Fund for Conservation, community development organizations like SPECTO and SADO, small businesses like dive shops, and larger businesses like the Sandal Foundation. Evidence of clean-ups are widely documented in the newspapers (42/235 articles); frequently, organizers report the number of bags collected as well as the most frequently collected items. For example, during field work, I participated in a clean-up in True Blue. Reports from this event indicated that participants picked up over 60 bags of garbage, with the most frequent items being plastic bags, plastic cups, and plastic bottles (True Blue Bay

Figure 6.6 Overflowing public bin in Grenville, April 1, 2019

Boutique Resort, 2019); I also noted that there was a significant amount of construction waste (Field notes, April 3, 2019).

Participants expressed frustration with the reliance on "clean-ups" as the primary means of dealing with litter or as a public relation, one-time event (Participant D, Focus Group B, D, G). For example, one focus group suggested that residents often do not participate (Caribupdate Weekly, 2015) or do not realize the value of not littering in the first place.

> *"The attitude is, we will come and help you all clean up that area ... because the community doesn't see the benefit of them keeping their area clean. …This group is coming to clean up a beach, so we're going to go help them not realizing that you're actually helping yourself." (Participant, Focus Group B)*

One participant mentioned a controversy at a Telescope clean up that occurred in February 2019 (Participant J). The clean-up was organized by the Grenada Fund for Conservation. Newspapers and

participants reported that community members were calling for the Imani program to provide labor for beach clean-ups (Grenada Green Group, 2019). Participants further indicated that the community was not participating in a clean-up (Focus Group B; Participant J). A participant in a focus group suggested that community members were "just watch[ing] us, like there's a movie going on.", and in passing "they are cleaning!", but not willing to help. This was the sentiment that was also expressed at the Grenada Green Group meeting attended by me (Field Notes, March 20, 2019). It was evident from this conversation that a number of engaged citizens were frustrated with the lack of participation or concern from people that resided in the area. During this conversation, several participants suggested that Grenada is a reactive nation, not proactive: *"The few of us that are, are outnumbered …And it's extremely exhausting" (*Participants, Focus Group B).

Furthermore, one participant suggested that *"some things that are not a priority in Grenada, often become a crisis"; in other words, participants were critical of the country always being in a state of reactiveness* (Focus Group B), in which people were always cleaning up instead of preventing litter in the first place.

> *"It's sad but the thing is that we have we have a mentality that we don't seem to notice the danger of something unless it hits home. And when it hits home obviously, we tend to right then try to get sentimental. I want everybody to come on board because it affects you personally. But if it doesn't affect you the personality then we can't be bothered. And we take that sort of temperament to every single thing ...I just cannot be bothered, unless it hits home." (Participant, Focus Group B)*

In contrast, two participants suggested that their own communities took a lot of pride in their surroundings and regularly picked up waste (Participant A, D).

> *"We take pride in our surroundings, where you live. people every so often down where I am, whoever is in the community will come out Sunday mornings and picks up plastic bags and stuff." …So, if today you go into the shop, "we ain't got no plastic bag" and you forgot to bring your bag, tomorrow you will remember." (Participant A)*

Participants found it frustrating that people are willing to put lot of care and time in keeping their houses and properties clean, but they don't care if in the process of cleaning, they dispose of their waste badly (Focus Group B).

> *"Grenadians are very particular about keeping their yards clean. You wouldn't do it in your yard, so why [are] you doing it? Isn't Grenada yours? [Isn't] all of Grenada yours?" (Focus Group D)*

After one member of the focus group mentioned that there used to be a dumpsite in Grenville (Chapter 5), another citizen indicated that they thought a solution to frequent dumping was to have waste depots or transfer stations in all the parishes. People could drop off their waste at the depot whenever they felt like it, instead of waiting for specific days for disposal. This does not negate the need for further processing (i.e., reuse or recycling) (Focus Group B), but intuitively, if it is easier to drop at the waste depot, there would be less dumpsites around the country. This statement was particularly interesting, due to the documented opposition to having a transfer station in St. Andrews during previous public consultations on waste management in the area (Rosenberg and Korsmo, 2001). Consequently, for both improved collection) and countering littering and dumping, *more bins and areas for disposal* were desired by participants (Participant H; Focus Group A, B, G).

## 6.5 Citizens as islanders – remembering island approaches to waste management

Despite the waste management challenges in the island nation, Grenadians engage in reduction and reuse strategies within their households, communities, and businesses every day. Several participants suggested strategies to reduce the metabolic burden and waste accumulation; these approaches drew on existing or previous knowledge and habits and were not simply improving the efficiency and effectiveness of the current collection and disposal systems. Some of the suggestions involved rethinking the role waste management and broader consumption system entirely.

It was evident throughout my conversations with community groups and individual citizens, that public participation *must play a role* in a future waste management system, and in that respect have a lot to contribute to the design of that system. While the government plays an integral role, Grenada cannot continue to rely on foreign money and big projects as the only avenue of change (Participant B, J; Focus Group C, D, F).

Participants in this study demonstrated a passion to *do something* about the current waste management situation in their communities and parishes. This was demonstrated through the success stories of organizing clean-ups, community meetings and trainings, and quite frankly, their willingness (and passion) to talk to a foreigner about waste management challenges in their country.

> *So, it all goes back to... awareness and education. We probably need to start doing something. It might take a while, but you have to make it innovative and creative (Participant, Focus Group B).*

For many participants, the work (i.e., where change happens) is in the people on the ground, not with 'experts' from outside the community (and the country) (Participant B, N; Focus Group F), and more importantly, participants want to be heard (Participant G, N).

> *We know the issues, but just waiting and sitting in our own mess. In small islands, [we] think someone else knows better ...we could do it, but have mentality that we're not good enough. We can see the issues, but have mentality that someone else needs to tell what needs to be done. (Quoted in notes, Participant N)*

In light of the Covid-19 crisis, and ongoing issues with the dumpsite fire, one author made a particularly persuasive argument: there is an opportunity for change by leveraging and valuing public participation.

> *The current Covid-19 situation and the current challenge of the landfill fire presents an opportunity for the Grenada Solid Waste Management Authority to introduce some* ***measures which require the active participation and cooperation of we the people*** *to alleviate the incident of fires at the Perseverance landfill and the resultant air pollution. While it would not solve the problem this year, we would be well on our way to alleviating/preventing that problem in 2021. (Environment Division and UNDP, n.d.)*

One participant wrote on their depiction of a future waste management system "*waste should be seen as a resource by the government and be given priority"*, and when asked to explain, they indicated:

> *We shouldn't just look at this as rubbish or waste. We could actually make money from renewable energy, or something. (Participant P).*

It is evident from my conversations that there is a desire for change. The following sections present evidence of existing or previous habits and practices that can be drawn on in formulating an island-designed waste management system. The results are summarized in Table 6.3.

| Main finding: | Number of participants: | Participant sample quote: |
|---|---|---|
| Passion and motivation to do something; recognizing that change happens at all different scales; top-down leadership is one way but has been unsuccessful in Grenada. There is an opportunity for bottom-up leadership and community work – many participants are already leading the way. Recognizing citizens values as participants, and that big projects and experts are not always the answer. | Participants: A, B, G, N<br><br>Focus groups: B, D, F, G | "We know the issues, but just waiting and sitting in our own mess. In small islands, [we] think someone else knows better ...we could do it but have mentality that we're not good enough. We can see the issues but have mentality that someone else needs to tell what needs to be done." (Quoted in notes, Participant N) |
| Refusing and rethinking consumption of various products, especially plastic bags, and electronics/small appliances. Importing durable, instead of inferior products, including inferior vehicles and tyres. | Participants: A, B, C, D, E, F, J, N<br><br>Focus groups: C, D | "…one of my favourite bakeries, they usually give you a plastic bag with all the other things in it. I will tell them okay, I don't need a bag I'm going right to my van, it is right outside. So, I won't take it. So little things like that. Just the awareness that every single bag you take is an additional bag that is purchased." (Participant D)<br><br>"Because we bringing in too much vehicles. And they are too old. So by the time they get here, they don't have much life, and we have to keep bringing in more and more. That again is building up our waste" (Focus Group E) |
| While one participant recalled the reuse and refilling habits from previous times, other participants mentioned 'Refill shops" as innovation from larger countries that could be implemented. | Participants: A, B, D, R<br><br>Focus groups: A, C | "Shops are coming in into big countries now. Where you bring your own container and fill them with goods. From very big containers, which are then sent back to the manufacturers and refilled. So essentially no containers are involved. There's no reason that shouldn't work here. No reason you shouldn't have a great big tub of shampoo and fill your bottle with it." (Focus Group A)<br><br>"… you'd have your one kerosene tin for years. You just reuse... But now is every time you use a bottle of ketchup, you have to buy a new bottle. You use mayonnaise, you have to buy a new bottle ... everything you use, you get a new container." (Participant A) |
| Repurposing materials, such as glass bottles for glassware, grinding glass into sand, reusing tyres for planters | Participants: A, B, C, D, J, K, Q, S | "There is such a huge deficit of sand. There is no commercial benefit to crunch glass and throw it in the sea. But there is a huge environmental benefit to do it. So, this is something a country can take up and say, "You know what, we have a policy to put the glass |

| | | |
|---|---|---|
| | Focus groups: C | back into the sea, because eventually it will become sand again" and you just do that and you do that especially at area where you have massive erosion." (Participant K) |
| Island-generated goods. Using waste as a resource. Stockpiling resources until markets or uses become available. | Participants: C, D, G, N, O, R<br><br>Focus groups: A | "We shouldn't just look at this as rubbish or waste. We could actually make money from renewable energy, or something." (Participant P)<br>"…how I imagine our ideal management system. So, … the product are either transformed into another product. There would be less garbage, therefore as garbage is coming in, they are, they are put into the system to be converted into something else" (Participant G) |
| Provide incentives for CE strategies, such as adding deposits on more goods, like bottles. | Participants: H, Q, R<br><br>Focus groups: A, B, C | "It would be nice if we could introduce a law which required glass bottles to have a deposit as beer bottles have. Jam jars aren't. All kinds of glass receptacles could attract a deposit, and it would be nice if we could do the same with plastic bottles. Somebody said, water companies don't produce water, they produce plastic bottles. I think the deposit system on them which could be legislation that we're talking about, so that they can be retrieved and restored into until something to do with them instead of just throwing them into the rivers" (Focus Group B) |

Table 6.3 Main findings of citizens as islanders

### 6.5.1 Refusing, rethinking and reducing consumption

In one particularly meaningful conversation, I learned about previous practices of consumption; the participant reflected about how an ideal waste management system for them was returning "*back to basics*" and not stressing about *"competing with the Joneses"*; in other words, for this participant, the 'rat race' of growth and competition was resulting in more waste and more problems for society. For this participant, there was a desire to return to the days when life on the island was more 'wholesome', and islanders used what they had and made do with what is available on the island (Participant A).

> *It's simpler. It's a nicer way of living. Because you're not competing with the Jones… To get this and this, and if they have that, I have to get it better. Just live. They get it better just to show, 'Oh, I got a big car.' Can it get you from A to B? Yeah, so, can mine. … Competing with the Jones. (Participant A)*

This participant expressed wishes for Grenadians and Carriacouans to: *"… Be content with what you have. I don't want much, you know, just to be comfortable. And I'm just as good as anybody else"* (Participant A).

Another participant indicated that to a foreigner, Grenadian household the waste management practices may not appear to be 'sustainable' as waste is not separated at an institutional level and it ends up in a dumpsite. But, while the term 'sustainability' may be a new, the practices and behaviours of 'making do' are widely practiced in Grenada. These are often unseen by foreigners who are used to a more formalized waste management structure:

> *Often foreigners come in, and they will be living here for a while, and are like "we introduced this" but it's like actually it's not new.* ***We used to do it in Grenada****. The idea of 'sustainability' is new, [but] for people who don't have money....people make do, find ways to stretch things.* ***So, that principle of sustainability has been here****. (Participant 24)*

Therefore, Grenadians have a history of 'making do' through reimagining consumption, reusing materials, and creativity, which are often ignored in formalized waste management systems. For example, one participant indicated that food is often used as animal feed, and people rarely purchase dog food, for example (Participant 25).

The idea of sufficiency and conscious, intentional consumption was illustrated by one participant, as they reflected on Grenadians being 're-cultured' into consumerism:

> *It takes so much time just to strip one of these things [i.e., a toaster], to separate all the parts so that we could properly recycle the parts and use it again. It kind of doesn't make any sense and probably one of the solutions arises: why not, not use a toaster? But the real problem is that we have been* ***consumer re-cultured****. We get used to having certain things, that the only statement we have is, that is for somebody to* ***figure out what do you do with the waste after****. And so that cultural malady is probably the serious issue that might result in us never finding the kind of waste management economy we want to find, that kind of circular economy.*[38] *(Participant 4)*

According to this participant, solutions need to go beyond how to collect and process waste materials (i.e., end-of-pipe solutions); and examine the purpose of the product and determine if it is necessary in the first place. The participant reflected on the perceived sacrifices that people would need to make into order to realize a more circular economy[33]. There are obvious hesitancies in enforcing control on people's consumption habits and preferences.

> *…because there might be some sacrifices we have to make to take things out or use things that are a little different by composition. It's kind of difficult for people to go back to and maybe there's a fear of people thinking that if we are to achieve this [a more circular economy], we gonna bring ourselves back to the Stone Age. (Participant 4)*

A resident of Carriacou had a number of examples of changes in society that had led to the increase in consumption and generation of waste. In years past, weddings, for example, required the community to work together: preparing the food, lending 'good' dishware for the table, and helping with washing the dishes. Now, events on the island tend to use single-use tableware, which results in bags and bags of waste being deposited at Dumfries.

> *Every function you go to now, we must have a plastic plate. And I'm wondering what they used to do before? It was wholesome. You didn't have all these bundles of waste. Because after every function, there's bags and bags, packed up. Full of one wear, one use. (Participant A).*

Another topic related to reduction was the use of washable baby nappies. The participant indicated that mothers would take pride in washing baby nappies; it was not disgusting, but rather an expression of love that bonded a parent to the child. But now, like the rest of the world, parents are strongly reliant on disposable 'Pampers' in rearing their children (Participant A). For this participant,

[38] As part of the interview process, interviewees were asked about their existing knowledge of the concept of the circular economy.

it was possible to remember and utilize the 'basics'; but it required citizens 'retraining' their minds and being disciplined (Participant A). For this participant, the government's recent ban on some single-use plastics would challenge people to think differently:

> *What the government has done, in the reducing the plastics. Banning it. So, all that stuff , when they can't get it, you've got to start thinking differently. Because it's not at your fingertips anymore. And education. Keep realizing that it ain't doing us no good. We're dying slowly from all of the rubbish. And the things that we're just picking up easy….Not good in the long term. Killing yourself (Participant A)*

Similarly, a participant in a focus group indicated that Grenadians needed to rethink their consumption patterns and refuse materials as much as possible:

> *And so even before we reduce, I think we should learn to refuse and certain things.... And that's the first 'R', I would think. My young people told me about rethinking first, got to get our brain re-programmed. But... because it starts from the way we think, you know, we think we can't have, we can't do with certain things,* ***we just have to rearrange our thinking pattern****. So, rethinking first and then refusing, trying to not take things, if as a country, not to use things that are individually packaged or packaged with things that could be degraded or degraded, rot and stuff. So yes, I think that the ideal [waste management system] for Grenada is that we would, from this point forward is to try to use so much less … and for the material that cannot be rotten down. And, of course, to use more things that could reuse more of the things that could be used for other things. We don't have recycling system here in Grenada as such. But we could do our own thing that could be reused and reused and so… (Participant, Focus Group D)*

One participant described how they began in their church and encouraged church members to not use Styrofoam at functions because it did not biodegrade. For this participant, the change process began with individuals and small groups talking about changes in habits.

> *…probably some of us have had to lobby for legislation, because this is how the Styrofoam [ban happened]. Some of us were talking about it for years. (Focus Group D).*

Some participants indicated that legislation banning materials forms a critical part of getting people to re-think their consumption patterns.

> *I think people will adjust…Just like how they came to this stage where they are using it. They will learn now that it is of no use, it does you no good. We will change our thinking just as fast. (Participant A)*

Several participants actively refuse plastic or used as little plastic as possible (Participant C, D; Focus Group D). For example, one participant suggested that they had begun to rethink their purchase of deli meat because of the inevitability of it coming in plastic packaging. They reflected on their effort to refuse plastics but noted that Grenadians are *set in their ways*

> *I started it personally at the beginning of last year. So, for example, if it's one item that I can put in the palm of my hand, then no need for me to have a plastic bag. So I'll refuse the plastic and then one of my favourite bakeries, they usually give you a plastic bag with all the other things in it. I will tell them okay, I don't need a bag I'm going right to my van, it is right outside. So, I won't take it. So little things like that.* ***Just the awareness that every single bag you take is an additional bag that is purchased.*** *(Participant D)*

### 6.5.2 Reusing and repurposing materials

Grenadians have a long history of reusing and repurposing materials. Observations indicated that people reuse jam jars for making their own preserves for selling at craft and artisanal markets (Field Notes, December 9, 2018). Beer bottles are reused to sell toasted cashews and other seeds and nuts, in addition to being returned to the breweries for refilling (Figure 6.8). According to one participant, St. George's University used to collect jam jars and other items from students, and people could phone up and request to pick up items (Participant B) (Environment Division and UNDP, n.d.). It was evident that "*There are small pockets of this happening"* (Participant B), but for the most part, packaging is not being reused to a large extent in the country; for participants in my study, this represented a significant opportunity to remember reuse practices used in earlier year and scale up or replicate existing practices across the country.

In Grenada currently, there is limited 'bulk food' or refill stores that allow customers to reuse containers or packaging. One participant indicated that in Carriacou, refilling used to be the norm (Participant A). For example, the store would have large containers of a particular product, like 5 gallons of cooking oil, and patrons would go to the store with their container to be refilled.

> *You used to reuse the bottle, like the cooking oil bottle. You would buy, you would get a bottle, and you save it. You go to the shop here; they pour in the cooking oil. So, you reuse it. Like the*

*butter containers, you used to do the same thing….They used to put the butter on a piece of greaseproof paper. And you just go home and put it in whatever container you want. So, butter, lard, and Vaseline was like that. Baking powder, they used to put it in a little paper and fold it nice and neat. We didn't have plastic bags, we use paper bags and a lot of wrapping paper (Participant A)*

The participant reflected on the wastefulness of the current system, in which whenever you need a product, you must also purchase the packaging that it comes in.

*… now is every time you use a bottle of ketchup, you have to buy a new bottle. You use mayonnaise, you have to buy a new bottle, use cooking oil, you got to get a new bottle. Use margarine you have to get a new …everything you use, you get a new container. (Participant A)*


Figure 6.7 Examples of beer bottle reuse.
A) Beer bottle used an alternative packaging, January 22, 2019, B) Beer bottles arriving at the Carenage, March 25, 2019

Another participant stated that water bottle companies do not sell water, they sell plastic (Focus Group A). Ironically, other participants saw refilling models as an innovation or change, that could be incorporated in Grenadian society by adopting 'big country' practices:

> *Shops are coming in into big countries now, where you bring your own container and fill them with goods from very big containers, which are then sent back to the manufacturers and refilled. So essentially no containers are involved. There's no reason that shouldn't work here. No reason you shouldn't have a great big tub of shampoo and fill your bottle with it. (Participant, Focus Group A)*

> *…there's this thing. I don't know if you'll ever get to that here. Where like, if you have to get meats and whatever stuff, you can bring your own containers. But I don't know if Grenadians would ever like that. I don't know if it will catch on. They probably thinking too [it is too] Western or some Americanized or Canadian or whatever. (Participant D)*

From my conversations with participants, it became evident that there is a reuse opportunity by *remembering* old practices and implementing them as innovative ideas. For example, developing a reuse network in which artisans could buy bottles for their products could generate revenue and keep materials in circulation (Participant Q; Focus Group E)

> *In Grenada, we have persons going into business like making coconut oil and so on, seasoning and so on, so these people... When we use these bottles, and we have them is garbage, then we can sell it to a company, whatever company that might be. And the persons that are into the small business, they will go and buy the bottles for the business. So, it will be recycling the same bottles over and over. (Focus Group E).*

Participants also indicated that local companies, like Baron's Foods manufacturing and the Grenadian Bottling Company (who bottles Coca-Cola on the island), could develop a return system, which reduced the amount of plastic and glass packaging going to landfill. Participants in a focus group indicated that Coca-Cola could return to the glass bottles for local consumption (Focus Group E), similar to how they bottled their beverages prior to using PET plastic.

> *There are a number of glass containers like all of the Baron's stuff. But, they have a factory here. And all of the local [products]. These [bottles] could all be resold, to the same people. You don't*

> *even need to crush it. Just clean it… the same way that the brewery does their beer bottles, clean them put them back for sale.... (Participant K)*

Rum distilleries in Grenada do not reuse their bottles, or if they do, there is not a clear return process. Conversations with a representative from the rum industry suggest that the distilleries either lack of infrastructure or incentives to develop a return, reuse, and refill system (Participant 20)[39]. The West Indies Brewery, however, offers a compelling incentive to encourage patrons to return their imported (and expensive) beer bottles: a deposit that ranges from $0.50 - $1, or if you'd like to stay for a drink, a $2.50 bar tab *(*Field notes, October 27, 2018*)*. The Grenada Brewing Company also has a deposit program of $0.25 per bottle for Carib and Stag brands of beer. Imported beer bottles were not accepted as returns; in Petite Martinique, it was evident that the bottles were not valued economically from the extend of dumping of bottles on the island (Figure 6.9; Field note, February 19, 2019).

Several participants suggested that a deposit, like beer bottles, could be applied to all glass and plastic packaging.

> *It would be nice if we could introduce a law which required glass bottles to have a deposit as beer bottles are, but [other] bottle are not. Jam jars aren't. All kinds of glass receptacles aren't but could attract a little deposit, and it would be nice if we could do the same with plastic bottles. Somebody said,* ***'water companies don't produce water, they produce plastic bottles'****. And I think the deposit system on them, which [would require] legislation, so that they can be retrieved and restored into something… instead of just throwing them into the rivers. (Participant, Focus Group A)*

Participants were able to easily identify alternatives that used to be present in Grenada; for example, one participant indicated that that her parents had a grocery, and families would bring wicker baskets to carry their groceries (Focus Group D).

> *… when I was growing up, we didn't have plastic shopping bags and we shopped. So, I don't see why now we think that we cannot. …A simple thing like a cloth, fabric bag could service for years … We don't need those plastic bags. (Participant. Focus Group D)*

[39] Following field work, the Blue Light Distillery advertised refilling opportunities for gin on social media on September 9, 2021 (https://www.facebook.com/BlueLightDistillery/photos/a.1168177646674573/2058134201012242/?type=3.)

For materials that could not be reused for their initial purpose, there are a number of repurposing examples evident in Grenada. For one participant, an ideal waste management system included using ideas from Pinterest to creatively reuse tyres (Participant D; Figure 6.2). There are a number of examples of the repurposing of tyres around the country, from embankments to flowerpots to seating at the Pure Grenada Music Festival.

A number of participants referred to efforts at La Phare Bleu, a hotel and marina, and GreenzMatterz in Westerhall as examples for repurposing glass bottles. The owner of La Phare Bleu had bought a glass cutter and was encouraging the development of entrepreneurial activities using wine bottles, sparkling water bottles (glass) and other liquor bottles into drinking glasses (Participant J). At the time of field work, however, this enterprise was not in operation (Participant G, K). Online evidence indicated that GreenzMatterz[40] is operating, and based on their Facebook page,

Figure 6.8 Bottles in Petite Martinique, February 17, 2019

providing glassware to hotels and other businesses, and participating in artisanal fairs. One business

[40] GreenzMatterz Facebook page https://www.facebook.com/greenzmatterz473

owner informed me that they use GreenzMatterz's services to make drinking glasses, repurposing alcohol bottles in their bar (Participant Q). For one participant, this was an example of taking waste and turning it into something that can be used in the local, tourism and souvenir markets (Participant J).

Participants mentioned that grinding or crushing glass would be another way to deal with glass in the dumpsites, while also alleviating some of the economic pressure to either import sand for construction (Participant B, K; Focus Group C).

> *[Currently] glass goes back to the landfill. But…this would be so easy there is a huge deficit of sand. There is no commercial benefit to crunch glass and throw it in the sea. But there is a huge environmental benefit to do it so, this is something a country can take up and say 'you know what, we have a policy to put glass back into the sea, because eventually it will become sand again' and you just do that and you do that especially at areas where you have massive erosion (Participant K)*

This suggestion aligned with an expert interview with a construction industry participant (Participant 27), who had sought out quotes for a crusher that could crush glass to be used in concrete.

At a consultation in Carriacou, one attendee indicated that there is a need to turn waste into a resource; one example provided by the attendee was flaking plastic or grinding glass to use it as a resource (Field notes, November 29, 2018). In 2020, an organization has formed in Carriacou called "Climate Save Actionists" and "No to Single Plastics Association" who were collecting and grinding plastic to be added to concrete cinder blocks for construction. As of August 11, 2021, online evidence indicated that the project needed investors after failing to convince funders, the Government of Grenada and the GSWMA of their initiative.

This example reinforces one of the challenges identified by participants: motivating people to engage in entrepreneurial activities. When I asked participants "How do we make projects more sustainable?" (i.e., lasting beyond the project scope), participants indicated that typically when project funding ends, so does the project (Focus Group B, D).

> *Grenada is very project oriented. We have a project; it lasts for 5-years. We get funding for it. And the project comes to an end, and whatever was done for the project, comes to an end. (Participant, Focus Group D).*

Echoing similar concerns, another participant indicated that there is rarely follow-up from a project and there is little reflection about how the lessons can be sustained *"…. And when we finish with it, no lesson learned. It's not sustainable." (Participant, Focus Group D).* But some participants were hopeful that if people are passionate about the project, it could be sustained: "…if you have a passion for something and you have people who are passionate as you are, it doesn't matter if there's funding or not." (Focus Group B)

The challenge for this passionate set of participants, however, is that those who are passionate about initiatives are also *really busy people* (Focus Group B; Participant J). Participants suggested that there is a barrier to motivating young people to get involved (Focus Group B), and another participant indicated that did not seem that young people were serious about getting involved or making changes (Participant H). One idea that emerged was motivating youth to pick up litter through the promise of party or club passes as an incentive, but there may some issues associated with purely external motivation. In contrast, however, others indicated that young people's voices were not being heard by the government, and this was a significant barrier to change (Participant G).

Throughout my conversations, participants expressed frustration with the government's approach to ensuring a sustainable future. One participant was frustrated with the way that government engages with ideas from the public, particular young people.

> *Even if we go to the government and say we have this idea, what do you think? They would just tell use 'Yes' and then after a period of time, they will just dump it to the side and that's it.* ***Nothing is being done.*** *(Participant G)*

The participant described the government as *autocratic*, not democratic, and felt like they themselves did not have a voice or say; they just had to listen to the government and do they were told. This aligned with another participant, who indicated that Grenadian society is very hierarchical, and no one truly values the opinions of those on the lower end of the pay scale (Participant B). I asked the participant, who felt they were voiceless, to describe what they would do if they oversaw waste management. They indicated a more participatory, consultative approach:

> *I would make sure I go to each parish and make it known that I would be coming. I would go on days when most persons would be home, and* ***I want to get each person's opinion on what they think about the rising issues and try to get their strategies and implement it.*** *(Participant G)*

Furthermore, the importance of engaging young people was important for this participant:

> *…because we are the future, we are the future. The persons who are in government, they won't be there forever. We will have to take over eventually. (Participant G)*

There was also realization amongst participants that waste management is a complex issue that needs a systems-based approach. For one participant, there was no point in dealing with the *impacts* of pollution if you were not going to tackle the *source* of pollution; this aligned with the sentiment expressed by Participant 11 (Chapter 5). They had decided to change their career, to address the root cause of the problem.

> *When I started out like with marine biology, I wanted to be a marine scientist, but then I say to myself, why not tackle the source of all the marine problems? Which is waste. Whether it is sewage waste… solid. Number one issue would always the waste.* ***So why try to do coral restoration? Why not tackle the source of it?"*** *(Participant P)*

It became clear that waste management in Grenada necessitated a systems-approach, that recognized the importance of bottom-up knowledge, without losing sight of the importance of structure established from the government and the GSWMA, such as providing quality, consistent collection and enforcing laws. For one participant, artisanal recycling and crafting was not going to solve the issue of waste generation, and there was a need for system-wide recycling.

> *I think we have all these entrepreneurs trying to do their little part. We need a top-down approach and especially having to do with recycling. (Focus Group A)*

One participant expressed concern that the GSWMA was building a new landfill without having a clear strategy for waste management established.

> *…If you don't have the strategy, how do you build something; it's something that's going to cost a lot of money, it's going to take years to build. How do you make sure that these already integrate things that you didn't even make a strategy about yet? I mean, this is all back to front because once this money is spent in the landfill, there's no way they can do it again, just because 'oh, yeah well now the strategy says it has to be done differently...' (Participant K).*

This indicated that there is a need for a clear plan or vision from the GSWMA, but also strategic plans. For one participant, waste management cannot always be profitable, because it needs to be a

public service. One participant emphasized that shipping and exporting materials off the island may not always be profitable, but it needs to be done to protect the health of Grenadians and the economy.

> *If you are a private sector operator, it is at a loss to you. But if you're a public sector operator, it is at a gain to the country in any case. So now you're looking at health, pollution, your tourism product, you have a lot more things to take into consideration. So all of a sudden, even if it is at a loss, it is still profitable for the country to run it (Participant K)*

The participant emphasized that waste management services, including dealing with materials, needs to be a public good and you cannot rely on the private sector to satisfy the government's responsibility.

During field work, there were at least two exporters working on the island who collected materials from the dumpsites and hotels and business and had the option of citizens dropping off their materials at their locations. For example, one participant described their current waste management system at the household level including a storing of plastics (PET) cardboard and tin in a separate bin and dropping it off at Spice Isle Recycling in Woodland (Participant K). Evidence from the material flow analysis (Chapter 4) and expert participants (Chapter 5), however indicated that there was not a lot of materials that were getting exported off the island. Consequently, the fate of the materials being separated for "recycling" by some of the participants is unknown, and field work indicated that these materials were likely just ending up in Perseverance.

One interviewee[41] indicated that recycling businesses have tried to acquire more space and set up a business in the Perseverance area, but there has been little support from the GSWMA or the government to help establish more formal business arrangements. At the time of field work, the researcher observed remnants several 'diversion' companies that had gone under due to profitability, legal issues, or lack of institutional support (Chapter 5).

## 6.6 Chapter conclusion

Citizen perspectives and contributions form an important, yet underutilized, knowledge base for informing waste management initiatives in Grenada. From interviews, focus groups, brief

[41] Protecting identity

conversations, and observations, it became evident that waste management – the generation, collection, dumping and littering, and disposal of waste – is an environmental concern and justice issue. But it is not unsurmountable. Participants provided actionable recommendations that could be implemented immediately, as well as aspirational ideas that support rethinking waste management in Grenada. Traditional approaches – that is local, generational knowledge - can be remembered and drawn upon. In other words, improving waste management is not just about the latest technology but also remembering the skills, mindset and habits that informed social metabolism in years past. Additionally, there are innovative ideas emerging out of Grenada, as well as more-mainstream recycling approaches, that can be harnessed and utilized with the right institutional and legislative support (Chapter 5).

This chapter demonstrates the importance of local knowledge for generating new ideas and countering reductionism, often touted by professionals and consultants (Corburn, 2003). The participants illustrated the importance of recognizing citizen knowledge in their roles as participators and generators of waste, stewards of the environment, and islanders with a history of creativity and innovation. This research highlights what can be gained through including typically excluded voices, that is citizens, from waste management planning processes. While I was not able to target specifically marginalized communities or communities directly impacted by the dumpsites (i.e., communities near Perseverance and Dumfries), I am hopeful that and advocate for future research to highlights these citizen's voices as testimony to the impacts of open and illegal dumping in their communities.

# Chapter 7 Can trash be treasure in Grenada?

# Summary, recommendations, future research & conclusion

Grenada's waste management system is at a tipping point. A fire in June 2021 at the Perseverance dumpsite is the latest manifestation of a larger waste management problem: a linear, one-way flow of materials, and the accumulation of mixed waste in open dumpsites. Waste management is a social metabolic, social-ecological challenge This dissertation demonstrates that Grenada is exhibiting sociometabolic risk; the socioeconomic and environmental systems are unable to absorb the waste generated from the import-use-disposal economy. In this final chapter of the dissertation, I review the evidence presented in Chapter 4, 5, and 6, illustrating the challenges of Grenada's waste management system from a social metabolism perspective. Based on the research, I offer a set of recommendations on improving the social metabolism of waste from a material/biophysical, governance and social-cultural perspective. I further reflect on the importance of public participation as a source of information and innovation, to support improving Grenada's social metabolism.

## 7.1 Waste Management and Sociometabolic Risk: Summary of Results & Contributions

The sustainability of an island social-ecological system is dependent on both the biophysical, material flows and the social and social-cultural processes that support these material flow. Recalling that social-ecological system can fall into a 'metabolic trap' and become exposed to (socio)metabolic risk (Singh, 2020) through four sustainability challenges: (1) resource scarcity (2) a reliance on imports, 3) difficulty of absorbing the outputs of waste, and (4) an inequitable distribution of the costs and benefits of the social metabolism (Schandl et al., 2002). The dissertation results illustrate that Grenada is currently experiencing all four of these sustainability challenges and suggests that the social-ecological system, particularly flows impacting waste, are teetering on a tipping point of sociometabolic risk.

To date, social metabolic research has focused on the material flows of a social-ecological system (Chapter 2), and it is necessary to have contextually grounded material flows accounting to identify and understand sources of sociometabolic risk. The results of the material flow account of the waste management system, presented in Chapter 4, demonstrate that Grenada's economy is characterized by a one-way, linear flow of materials. There is very little circularity in the current Grenadian system.

Products are imported, manufactured, used, and discarded in the open dumpsites (i.e., Perseverance or Dumfries) or disposed in one of several illegal dumpsites throughout the nation. Grenadians generate approximately 1.14 kilograms per capita per day (kg/cap/day), less than the average 2.37 kg/cap/day generation rate average in the Caribbean (UNEP, 2019a). Generation rates, however, fail to account for the problem of waste accumulation in open dumpsites, and the resultant pollution and health hazards (e.g., burning from fires, surface and ground water pollution from leachate, and vector breeding in tyres and other waste). Both Perseverance and Dumfries are reaching capacity (Chapter 4, 5), and in absence of changes to current waste accumulation, these dumpsites are teetering on an environmental tipping point that threatens social, environmental, and economic health.

Through field work, I identified three problematic materials that were isolatable in trade data: plastics, tyres, and motor oil. Each of these materials present significant problems for the GSWMA and have serious environmental and health implications. In Chapter 4, I quantify these materials, using a novel method that combines trades statistics with waste weighbridge and characterisation data (Millette et al., 2019). The results emphasize the need for developing a governance system, including a management plans and reduction strategies for each of these categories of waste. Recently, the government of Grenada banned Styrofoam and plastic-handled shopping bags; this is an example of a 'refuse' strategy at a national level and is a commendable (and expandable) strategy that could be further employed.

From a material flow perspective, there are a number of benefits of reducing waste in Grenada's social metabolism. First, there is potential for direct cost savings because there is less garbage to deal with; these direct costs include capital costs (land fill development), remediation costs (dumpsite and landfill closures), and variable costs associated with garbage collection. These costs are currently funded through a combination of project funding for capital costs, and the environmental levy for variable costs; to date, I am unaware of any remediation efforts or spending associated with disposal site closures. Second, there is an opportunity for cost-savings at an economy level through optimizing imports and using existing resources on island. Virgin material and product imports could be substituted for processed waste materials, such as tyres. For example, as mentioned by one participant, using existing food waste and biodegradable waste to create compost would negate the need to import expensive fertiliser from outside economies (Chapter 4). This would decrease the import bill, as well as create employment opportunities in waste processing and manufacturing on

the island. Third, there are potential indirect cost savings in terms of the impact on human and environmental health. Currently, the impacts of waste are undocumented in Grenada (Chapter 5). Despite a lack of data, fires, vector breeding, and pollution *have a cost* to the surrounding human and biological communities. Lastly, and perhaps most importantly, *waste as resource* thinking limits the overall economic, social, and environmental costs that will be borne on future generations of Grenadians and the critical ecosystem services that are impacted by today's pollution. Consequently, the findings (Chapter 4) suggest that there is an opportunity for stronger waste governance that manages and leverages the flows of waste in Grenada's social metabolism and emphasizes the importance of context-specific assessments of material flows.

Analysis of governance systems and citizen perspectives have not been widely used in social metabolism research (Chapter 2). Therefore, building on the waste account in Chapter 4, Chapter 5 makes an important contribution to social metabolism research and generates contextually specific knowledge for Grenada.

The results in Chapter 5 demonstrate that Grenada has a legacy of past governance challenges in waste management. The governance gaps have contributed to, and enabled, sociometabolic risk in the islands. To date, the GSWMA has put a lot of stock and promise in incremental, technical solutions that address the collection and disposal of waste (Chapter 5). In traditional waste hierarchy thinking, as well as circular economy approaches (Chapter 2), landfilling and incineration are avoided and considered *last resort* options. The government of Grenada and the GSWMA have a long-term (yet, unsuccessful) focus on building a sanitary landfill, without addressing diversion or separating waste (Chapter 5); this 'end-of-pipe' approach aligns with typical approaches in the waste management literature (Chapter 2) but, it runs counter to hierarchical thinking.

Grenada's current legislation is lacking, including the absence of an overarching environmental management framework and land-use planning policy (Chapter 5). Furthermore, existing legislation is inadequately applied, outdated, and lacking adequate regulation, policies, and management plans to implement. Notably, many polluters do not pay for waste management services; penalties and levies are not adequately or robustly applied and are not reflective of current consumption patterns (Chapter 4). Furthermore, the government of Grenada lacks requisite data to make decisions. Grenada would benefit greatly from facilitating and mandating the collection, access, and use of data in waste management and environmental management decision making. Finally, both data and engagement with global and regional governance mechanisms, can provide both motivation,

funding, and capacity for implementing governance mechanisms in Grenada. Overall, the results from Chapter 5 demonstrate that the state of Grenada has a lot of governance gaps that need to be filled before even implementing sound waste management with the most basic waste hierarchy framework.

Public participation could serve as a useful tool in effective waste management, yet, in Grenada, the role of the public is rarely considered. Chapter 6 reviewed results from my conversations with citizens and active community groups in Grenada. These conversations demonstrated the value of public participation through the variety of voiced perspectives and concerns. As waste generators, participants reflected on the importance of reducing and sorting waste, and emphasized the importance of equitable, quality collection service around the country. While the GSWMA has actively discouraged or removed public bins, citizens *want* bins to put their waste out daily. Consequently, there is an opportunity to work with citizens to create more infrastructure and opportunities to dispose of garbage.

As environmental stewards, citizens expressed concern with dumping and littering in the country, and the state of the dumpsites as locations of environmental threats. Education, enforcements of laws, and infrastructure development were viewed as solutions to prevent continued waste management problems.

Finally, citizens had a lot of ideas for dealing with waste, using existing knowledge and creativity. The participants had several ideas for reducing and reusing waste- demonstrating both a passion and call to *do something*. This chapter highlights what can be gained through including often excluded citizen voices in the waste management planning processes.

The empirical results of this dissertation demonstrate the challenges and concerns with a waste management system. The current practices, consumption patterns and material flow of waste management, across scales, threaten the social metabolism of Grenada. In other words, the waste management system has sociometabolic risk, as the island system is unable to cope with the current waste management system. This leads to an obvious question, and the primary research question of this dissertation: **what opportunities exist for islands to sustainably manage their waste?**

## 7.2 Recommendations for establishing sustainable waste management in Grenada

This section contains specific recommendations gleaned from the research to improve Grenada's waste management and reduce social metabolic risk. Table 7.1 provides a summary of the specific recommendations included in this section of the Chapter based on the research. Drawing on my sustainability and international development expertise, I crafted possible monitoring and evaluation indicators that can be used by the responsible parties to measure progress on these recommendations. Lastly, I identified possible financial implications with some specificity, where applicable or possible. Both the indicators and financial implications are meant as a starting point for the Government of Grenada to implement recommendations of this dissertation. Many of the recommendations emerging from the research align directly with the implementation plans from the National Waste Management Strategy, and the referenced Dillion Consulting report (Chapter 5). This further reinforces my previous assertion that the GSWMA has all the plans for action required – it is implementation that is missing (Chapter 5).

### 7.2.1 Establishing a strong environmental governance framework

In Grenada, governance for waste management and environmental management is ineffective, and this will limit future progress on pollution control, sound waste management infrastructure siting and development and use of environmental impact assessments as a planning tool. Grenada must first create a strong enabling environment that prioritizes environmental protection. Grenada does not have umbrella environmental legislation that protects the environment and limits pollution and ecosystem services degradation from development and business projects.

Grenada has a draft Environment and Natural Resource Management Act, but this legislation has not yet made it to Cabinet or Parliament (Government of Grenada, 2005, n.d.). The umbrella environmental legislation would provide an overarching legal framework for implementing a precautionary approach to development activities and ensure that polluters pay for waste management. Furthermore, as drafted, the act sets out expectations for the collection and dissemination of information (Section 9 of the Act) and environmental monitoring (Section 62 of the Act), assessment of environmental impacts (Section 15 of the Act), the management and disposal of hazardous waste (Section 29 & 30 of the Act) and prevention of pollution (Section 58 of the Act). The draft Grenada National Land Policy includes additions to the Act focused on natural resource management, including establishment of a natural resource management agency to

"coordinate the pro-active management of all natural resources to conserve biodiversity, reduce pollution from land and marine based resources, and support sustainable and environmentally sound social and economic opportunities." (pg. 21)

### 7.2.2 Update, implement and enforce existing legislation

Grenada has several laws that are not implemented and enforced or up to date. Table 7.2 presents a summary of the state of waste management laws in Grenada. Throughout the research, participants called for the government to enforce existing legislation. Furthermore, through the material flow account, it was evident that there is an opportunity to update existing legislation to be more reflective of consumption patterns. As one participant reflected that regulations and laws do not exist in a vacuum (Participant 18); consequently, amendments to laws and regulations must be justified with evidence. The following sections review specific actions to implement, enforce and update existing legislation in Grenada, based on evidence from the dissertation.

| **Legislation** | **Implemented and enforced** | **Up to date** |
|---|---|---|
| Grenada Solid Waste Management Authority Act (1997) | ☺ | ☺ |
| Waste Management Act (2001) | ☹ | ☹ |
| Environmental Levy Act (1995) | 😐 | ☹ |
| Litter Abatement Act (2015) | ☹ | 😐 |
| Non-Biodegradable Waste Control Act (2018) | ☺ | ☹ |

Table 7.1 Legislation impacting waste management in Grenada

The Litter Abatement Act (2015) is not being enforced due to lack of capacity and monitoring infrastructure. Consequently, citizens and companies dump waste and litter waste with impunity. The Abatement of Litter Act allows for the police, public health inspectors, forestry officers and litter prevention wardens appointed by the Ministry of Environment to issue fixed penalty notices for littering and dumping. Furthermore, litter prevention wardens are permitted to issue removal notices for litter and dumping that is expected to be a public health risk, namely carcasses of animals, derelict vehicles, abandoned machinery, abandoned white goods, and used tyres (Government of Grenada, 2018c).

| **Recommendations:** | | **Preliminary indicators** | **Responsible parties** | **Financial implications** |
|---|---|---|---|---|
| 1. Establish a strong environmental governance framework | 1.1 Pass draft *consolidated* Environment and Natural Resource Management Act. | 1.1.1 Number of public consultations<br>1.1.2 Environment and Natural Resource Management Act is passed by Parliament | Ministry responsible for the Environment | Cost of meaningful, substantive public consultation. |
| | 1.2 Promulgate draft National Land Use Policy. | 1.2.1 National Land Use Policy is approved by Cabinet | Ministry responsible for the Environment | No or minimal cost. |
| 2. Update, implement and enforce existing legislation | 2.1 Enforce the Litter Abatement Act | 2.1.1 Number of fixed penalty notices.<br>2.1.2 Number of removal notices posted for litter and dumping. | Police, public health inspectors, forestry officers and litter prevention wardens | Allocated time on existing responsible parties. |
| | 2.2 Implement and enforce the Waste Management Act | 2.2.2 Hire Waste Management Officer[42] to implement Ministry of Health's legislative obligations. | Ministry of Health | Salary of Waste Management Officer |
| | | 2.2.1 Number of regulations developed under the Waste Management Act (Section 46). | Ministry of Health | Development and enforcement costs. |
| | | 2.3.2 Identify commercial operations and hotels that are not delivering waste to Perseverance.<br>2.3.3 Inform ICI clients of their obligations under the Waste Management Act.<br>2.3.4 Establish schedule and progressively enforcement of ICI obligations. | GSWMA & Ministry of Health | Decrease collection costs |

42 Based on recommendations from the National Waste Management Strategy to assist in the Ministry of Health's legislative obligations under Waste Management Act and Litter Abatement Act

| | | | | |
|---|---|---|---|---|
| | | 2.3.5 Establish solid waste reduction targets by material category, diversion options and target dates for implementation. | GSWMA & Ministry of Health | Decrease collection costs; increase in waste processing costs. |
| | 2.3 Implement, enforce and update the Environmental Levy Act | 2.3.1 Implementation of a tipping fee at Perseverance dumpsite | GSWMA | Estimated revenue of $1.15 million EC. |
| | | 2.3.2 Addition of HS 3926.90.90 to First Schedule of Environmental Levy Act.<br>2.3.3 Revenue and quantity of preforms imported. | Ministry of Finance | Estimated revenue of $416,000 - $1.4 million EC. Trade costs associated with quantification. |
| | | 2.3.3 Addition of HS 3923.30.10 and 3923.30.90 to First Schedule of Environmental Levy Act<br>2.3.4 Revenue and quantity of bottles imported. | Ministry of Finance | Estimated revenue of $3.9 million EC. Trade costs associated with quantification. |
| | | 2.3.5 Amend the Environmental Levy Act to removing sub-section (2) of Section 5.<br>2.3.6 Revenue from tyre imports transferred to the GSWMA. | Ministry of Finance | Estimated revenue pf $800,000 in levy to GSWMA (2017). |
| | | 2.3.6 Addition of a deposit program on all glass and plastic bottles across import categories. | Ministry of Finance | Revenue neutral, with management costs. |
| 3. Participate in Global & Regional Governance Agreements | 3.1 Ascension of the Basel Convention | 3.1.1 Execute instrument of ascension of the Basel Convention<br>3.1.2 Collect requisite data on hazardous waste<br>3.1.3 Submit national reporting to Convention secretariat<br>3.1.4 Number of Management Plans for hazardous waste developed, working with Basel Convention Regional Centre for Training and Technology for the Caribbean | Ministry responsible for the Environment | Legislative and regulatory costs associated with meeting obligations. Outside funding for implementation. |

| | | | | |
|---|---|---|---|---|
| | 3.2 Obligations under the St. George's Declaration. | 3.2.1 Proportion of solid and liquid waste recycled, reused, or properly treated and disposed[43] | Ministry responsible for the Environment | Legislative and regulatory costs. |
| | 3.3 Obligations of LBS Protocol | 3.3.1 Number of plans, programs and measures addressing priority source categories and primary pollutants of concern in Annex I.<br>3.3.2 Number and extend of alternative production, waste treatment technologies and management practices in Annex II. | Ministry responsible for the Environment | Legislative and regulatory costs. |
| | 3.4 Obligations of Barbados Programme of Action | 3.4.1 Number of fiscal and policy incentives and other measures to encourage environmentally sustainable imports and local products with low waste or degradable waste content<br>3.4.2 Number of regulatory measures, including emission discharge and pollution standards, for the reduction, prevention, control and monitoring of pollution from all sources<br>3.4.3 Ratify and implement relevant conventions, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention of 1972), as well as relevant regional conventions. | Ministry responsible for the Environment | Legislative and regulatory costs. |

[43] Indicator from Goal 3 in St. George's Declaration of Principles for Environmental(OECS, 2006)

| | | | | |
|---|---|---|---|---|
| | | 3.4.4 Number of public awareness and education campaigns.<br>3.4.5 Number of clean technologies and treatment of waste at the source and appropriate technology for solid waste treatment.<br>3.4.6 Develop information systems and baseline data for waste management and pollution control, monitoring the types and quantities of wastes, for both sea- and land-based sources of pollution. | | |
| | 3.5 Ratify the Escazú Agreement | 3.5.1 Execute instruments of ratification<br>3.5.2 Enact draft Freedom of Information legislation<br>3.5.3 Include provisions for substantive public participation in environmental laws<br>3.5.4 Include provisions that give individuals legal stand to protect environmental rights and access to information. | Ministry responsible for the Environment | Legislative and regulatory costs associated with meeting obligations. |
| 4. Data and information collection | | 4.5.1 Collection waste weigh data on Sundays and Public Holidays<br>4.5.2 Install weighbridge at Dumfries dumpsite<br>4.5.3 Track and reduce accumulation of waste outside of the dumpsite<br>4.5.4 Conduct regular waste characterization studies (e.g., four times per year) with GSWMA personnel<br>4.5.5 Establish clearing house/database for environmental information and legislation.<br>4.5.6 Enact draft Freedom of Information legislation | GSWMA & Ministry of Health | Costs of data collection and capacity development<br><br>Cost of weighbridge<br><br>Cost of database establishment and maintenance |

Table 7.2 Recommendations for improving waste management material flows and governance

Litter and dumping are both unsightly and a potential health hazard for people in Grenada. For example, derelict vehicles on the sides of busy roads can prevent safe passage for regular traffic and prohibit entry to rural areas by emergency or disaster management personnel. Litter in the drains prevents proper drainage, increasing the opportunities for flooding. In terms of understanding the quantities of waste, littering, and dumping makes it very difficult to assess the value of resources and evaluate alternative diversion opportunities. Consequently, it is integral to develop capacity to and enforce the Litter Abatement Act. As per the National Waste Management Strategy, a Waste Management Officer should be hired at the Ministry of Health to help increase the capacity of the institution to enforce the Waste Management Act and the Litter Abatement Act.

The Waste Management Act (Government of Grenada, 2001) makes provisions for several regulations to support waste management in Grenada. To date, none of these regulations have been developed. As a result, there has been insignificant progress on implementing the Waste Management Act, and this has impacted the ability the GSWMA and government to implement the existing National Waste Management Strategy (Government of Grenada, 2003). For example, the national strategy is supposed to identify methods to manage hazardous waste and biomedical waste; these waste streams are currently not being managed through any special policies or procedures, and therefore represent a threat to human and environmental health.

The Waste Management Act indicated that the Waste Management Strategy should establish target dates from the reduction, recycling and composting of waste, and provides guidance of a 20% reduction by January 2010, and a 5% per decade reduction until 50% reduction is achieved (Section 5).

In Grenada, many waste generators and polluters *do not pay* or pay very little for waste management services. The 'Polluter Pays Principle' means that those who produce pollution should bear the costs of managing it. Currently, the costs that are levied under the Environmental Levy Act (Government of Grenada, 1997) are not reflective of the true cost of polluting; furthermore, these costs have remained stagnant for almost three decades in both per unit costs and product coverage. By enforcing and updating the Environmental Levy Act, the government of Grenada can ensure that the GSWMA can address waste management challenges beyond collection and disposal.

Industrial, commercial, and institutional (ICI) generators do not pay the GSWMA for waste management services by either circumventing the Waste Management Act by piggybacking off of the existing public system, or not being charged tipping fees at the dumpsites, as per the EVL Act.

Lack of enforcement of both the Waste Management Act and EVL Act is problematic as generators are not motivated to decrease their waste generation, and not paying their fair share for the services. Consequently, I'd recommend that the Government of Grenada and GSWMA ensure that all generators are paying their fair share for waste management services.

To implement a tipping fee, no additions to the Environmental Levy Act are required. In 2017, the GSWMA received an estimated 17009 tonnes[44] of waste to Perseverance from non-household, ICI customers[45] (Chapter 4). This equates to over $1.15 million EC in tipping fees that could have been collected by the GSMWA under the Litter Abatement Act (Table 7.3).

To enforce the Waste Management Act, ensuring that that ICI generators are making arrangements to deliver their waste, the GSWMA can begin by using dumpsite entry statistics to identify hotels, and commercial operations that *are not making* dumpsite deliveries. For example, identifying if large manufacturers and commercial operations are making regular deliveries to the dumpsite; if they are not, then a key questions from the GSWMA ought to be: *where are they taking their waste?*

| **Sector** | **Estimated waste delivery to Perseverance (tonne)** | **Total tipping fees** |
|---|---|---|
| Commercial and industrial | 8757 | $595,458 |
| Government services | 3706 | $252,040 |
| Institutional | 1838 | $125,010 |
| Ship | 241 | $16,413 |
| Tourism | 2466 | $167,699 |
| Total | | $1,156,619 |

Table 7.3 Potential tipping fees at Perseverance, 2017

GSWMA Public Relations and Operations should work together to design a campaign making ICI clients aware of their obligation under the Waste Management Act and provide recommendations on how to meet these obligations. For example, participants in Grenville noted that commercial operations can work together to hire a subcontractor to deliver their combined waste (Chapter 6).

The Environmental Levy Act needs to be updated to reflect current material imports in Grenada. Bottles of water and juice (HS 20 and HS 22) that are imported into Grenada are charged a $0.25 EC levy. Beverage manufacturers in Grenada that import 'preforms' and empty bottles for filling

[44] This does not include waste from Dumfries, as Dumfries currently does not have a weighbridge to record waste, and therefore there is not an accurate means of determining the quantities for individual deliveries.
[45] Includes all non-household classifications: Industrial, Commercial, Institutional, Government Services and Ship waste, based on MFA results (Chapter 4).

with beverages are not charged an environmental levy, despite generating an equivalent form of waste. A levy should be charged on all plastic 'preforms' and bottles that are retailed in Grenada. This is a potential multi-million-dollar levy opportunity, with estimates ranging from $416,000 EC to $4 million EC for preforms[46], and $4 million EC[47]. In comparison, Customs and Excise collected almost $3.2 Million EC for waters and juices in 2017[48].

As Grenada imports more electronic goods, management of e-waste is becoming a growing problem. An environmental levy of 1% of the value (Cost, Insurance and Freight or CIF) is charged on select white goods (HS 84) and small appliances (HS 85) entering the country. In 2017, Grenada imported a total of $30.5 million EC in computers (HS 8471) and phones (HS 8517). This would equate to $305,072 EC for managing e-waste.

Finally, the Environmental Levy should be used to fund waste management, not as a government revenue stream. The Customs and Excise division collected $2.4 million EC from 2015-2017 in environmental levies for tyres, or roughly $800,000 EC per year. Unlike the rest of the environmental levies, the levy for tyres is not intended to fund waste management, as the amendment (Section 5, Sub-Section (2)) states *"The levy payable on tyres shall not be paid over to the Authority."* The Ministry of Finance could amend the Environmental Levy Act by deleting this section, therefore allowing the GSWMA additional funds of $800,000 per year to develop a tyre waste management plan that addresses repurposing, recycling, recovery, and managed disposal.

Both end-of-pipe solutions (i.e., landfilling) and systems-base solutions require sustained funding and cannot simply be reliant on one-time or limited funding from projects. Consequently, related to updating and implementing the EVL Act, the GSWMA needs to develop more sustainable funding sources that reflect the materials flows of waste (Chapter 4).

### 7.2.3 Participate in Global governance agreements

To date, Grenada has largely dealt with waste management issues at a sectoral level and failed to address cross-sector linkages (e.g., linkages between waste management and health, agriculture, and social programs) and linkages across scales (e.g., opportunities through global governance

[46] This estimate is for a preform that weighs 14.1 grams, ranging from 10% to 100% of the HS 39269090 import code. See public files Dataset 1 for sensitivity analysis.
[47] This estimate is for a bottle that weighs 14.1 grams, at 100% of reported weight of HS 39233010 and HS 39233090. See public files Dataset 2 for sensitivity analysis.
[48] Includes all levies under HS 20 and 22, which includes both plastic and glass, as per data received from the Central Bureau of Statistics.

frameworks). To create an enabling environment for sound waste management, Grenada could benefit from capacity, support, and financing from global environmental conventions. Grenada has not yet ratified key pollution multi-lateral environmental agreements: the Basel Convention, the Stockholm Convention, and the Rotterdam Convention. Hazardous waste is specifically dealt with in the Basel Convention, with a number of reporting requirements aligning with Grenada's existing Waste Management Act. Grenada would benefit from ascending the Basel Convention with access to funding, capacity, and best practices through the with Basel Convention Regional Centre for Training and Technology for the Caribbean.

Grenada signed the St. George's Declaration of Principles for Environmental Sustainability (SGD) in 2001. This declaration aims to work toward harmonisation, synergies, and economies of scale in environmental management with OECS member states[49]. Principle 10 of the SGD addresses the prevent and control of pollution and waste. To ensure that environmental quality is not diminished by pollution and waste, the agreement calls for the following: creative implementation of reuse and recycling, control of land-based activities including waste disposal, and regional co-operation through the Cartagena Convention to prevent marine pollution.

Grenada is a signatory on the Cartagena Convention and the relevant Protocol Concerning Pollution from Land-Based Sources and Activities (LBS Protocol). This convention identifies activities and pollutants of concern in Annex I; pollutants include used lubricating oils and persistent, synthetic, and other materials, including garbage. Annex II outlines factors to consider for control and management:

a) Recycling, recovery and reuse opportunities;
b) Less hazardous or non-hazardous raw material substitution;
c) Substitution of cleaner alternative activities or products;
d) Economic, social and cultural impacts of alternative, activities or product;
e) Low waste or totally clean technologies and processes; and
f) Alternative disposal activities (for example, land application).

Consequently, addressing considerations in Annex II of the LBS Protocol would assist Grenada in developing a sound waste management system.

[49] https://www.canari.org/wp-content/uploads/2015/04/Geoghegan-St-Georges-Declaration-case-study-final.pdf

The Barbados Programme of Action (BPOA) addresses specific actions for SIDS to take in addressing the Management of Wastes (Section III). Under the 'National action and policies', Grenada has made strides on some of the action items, such as (i) encouraging environmentally sustainable imports through the Non-Biodegradable Waste Control Act, and (iv) public awareness and education campaigns. On other actions, like developing regulatory measures for pollution control (ii), Grenada's actions have been inadequate and largely absent. Appendix 21 provides an overview of Grenada's action for BPOA under waste management.

Grenada has signed, but not yet ratified the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (the Escazú Agreement). The Escazú Agreement promotes access and disclosure of environmental information (Article 5), the generation and collection of environmental data (Article 6) and public participation in environmental decisions-making processes (Article 7). All these articles are critically important to enhancing public participation and environmental protection in environmental activities.

Consequently, implementation of sound waste management and shifting to a resources management mindset has synergistic benefits in that it would assist in the ratification and implementation of existing obligations of the Grenadian government; furthermore, Grenada could benefit from the knowledge, capacity and support that are offered through participation in global governance frameworks.

### 7.2.4 Prioritize the collection of data and information

Data and information are powerful tools in both inspiring and demanding action, communicating sustainability messaging, and holding governments, agencies, companies, and individuals accountable for poor or unsustainable practices. Without information and data, it is difficult to sensibly evaluate waste management options; likewise, it is also easy to fall into a 'do nothing' trap, where plans and policies are written and re-written without any implementation. To improve waste management, and transition to the GSWMA's goal of resource management, data collection and transparency and information management must be improved.

For waste generation, data collection can be improved by 1) collecting waste weight data on Sundays and Public Holidays, 2) installing a weighbridge at the Dumfries dumpsite and collecting data 7-days per week, 3) recording and weighing the materials that leave the site and 4) tracking the accumulation of waste outside of the dumpsite. Furthermore, waste sorting would improve generation statistics. Several citizens indicated that there was an opportunity to sort waste at the

household or company level, to improve circularity opportunities and improve quantification of the waste generation statistics. In transition resource management culture, the GSWMA could conduct regularized (e.g., four times per year) characterisation studies that would improve both data availability and reliability of waste characterisation data, as per the National Waste Management Strategy (Government of Grenada, 2003). Finally, detailed records of illegal dumping sites and derelict vehicles would assist the GSWMA in having an accurate understanding of diversion potential and the need for clean-ups around the island.

There is limited knowledge on existing waste management practices that fall outside of the GSWMA purview. For example, while the GSWMA may be aware of waste recyclers/exporter operations, they do not support, guide, or have existing knowledge about the extent of their contributions to the circularity of resources in Grenada.

The Government of Grenada does not have a clearing house for environmental information, statistics, and policies. Furthermore, accessing legislation, especially original copies, amendments, and SROs, is difficult as there is not an up-to-date, comprehensive database.
The GSWMA's website could be a portal for relevant waste management documentation. For example, the Saint Lucia Solid Waste Management Authority has a section on their website for disclosing relevant studies including their annual reports and waste characterisation studies (https://www.sluswma.org/#).

## 7.3 Recommendations for public participation

Waste management is very complex and touches all facets of island life. As a systems thinker, I was routinely surprised by the number of stakeholders and considerations included and impacting Grenada's social metabolism of waste. By the end of field work, it became obvious to me why many previous waste management projects had not been sustained: they often relied on outside 'experts' to provide advice gained from few days of field work, without sufficient contextual knowledge and engagement with stakeholders, and based on a few interviews with waste management professionals. After 8 months of field work, I felt that I was only scratching the surface of Grenada's waste management system. *How could a consultant possibly make recommendations after a few days of field visits?*

I concluded that consultant recommendations were not built on a contextualized foundation, and therefore were not resilient or adaptable when faced with adversity. If something went wrong with a project, the consultants were long-gone and project funding had often ended; this was the case with

the failure of both the Perseverance and Dumfries landfills (Chapter 5). Furthermore, the written outcomes of waste management projects to date have failed to be implemented; for example, there are a multitude of action items in the Waste Management Strategy (Government of Grenada, 2003) that have not been realized (Chapter 5). This suggests that people 'on-the-ground' (i.e., the GSWMA) were not willing or able to implement measures suggested by consultants[50].

Waste management in Grenada is 'messy' materially (Chapter 4), it perhaps even messier from a governance perspective (Chapter 5). It is, therefore, necessary to embrace complexity and diversity and pay close attention to what citizens are saying 'on the ground' (Chapter 6) and less attention to so-called experts from outside of Grenada. I observed a waste management system that was a product of a top-down approaches, frequently informed by an external lens, looking outward for technology and 'best practices', while, in many cases ignoring citizens' perspectives and engrained habits.

So, while I do make specific recommendations in this chapter of the dissertation, **my primary recommendation is for the government of Grenada and the GSWMA to start looking at its existing capacity and resources on the island: namely, Grenadian citizens.**

Grenada, Carriacou and Petite Martinique are collections of strong communities and parishes, with small groups of active and engaged citizens at the helm of community development. Rethinking waste management in Grenada needs to engage community groups in community planning, budgeting, and projects design. Waste management can be improved by employing community members (not consultants) to understand community needs, collect community input and develop community-level waste management initiatives and plans. By incorporating resource thinking, many communities in Grenada would be capable in managing much of their waste themselves. For example, a number of community groups expressed interest in developing composting facilities in their communities to reduce the amount of organics leaving their community and benefit farmers and gardeners. Community members envisioned a direct benefit to their communities by keeping resources, instead of sending valuable nutrients off to Perseverance and Dumfries.

Citizens play an important role in waste management. The government and GSWMA would gain significant knowledge and capacity by recognizing and prioritizing public participation in waste management and resource management planning. As waste generators, citizens highlighted the need

[50] It is important to note that following the publication of the National Waste Management Strategy, Grenada was hit by Hurricane Ivan in 2004, which limited the country's ability to implement the strategy within the suggested timeframe.

for better, more comprehensive, and consistent infrastructure and service around the country. Grenadians need *more options* to dispose their waste, through sorting and diversion, transfer stations and drop-offs for reuse networks. Therefore, it is pertinent for the GSWMA to work with (not against) communities and citizens when developing collection and disposal plans and infrastructure. Citizens interviewed indicated that removing overflowing public bins merely downloads the problem onto more marginalized communities that still have public bins. Citizens also indicated a willingness to sort waste – but highlighted the need for quality infrastructure to facilitate sorting in each community. Consequently, the GSWMA and government need to find a way to work with communities, and this research highlights *what could be gained* from a broader consultation with the Grenadian public.

Grenadians also have a history of 'making do' through reimagining consumption, reusing materials, and creativity; but these habits are often ignored in formalized waste management systems. The GSWMA would greatly benefit from supporting citizen initiatives and ideas, fostering consciousness and ownership of waste management in Grenada. Citizen and community grants, participatory budgeting and citizen waste management committees would be helpful in fostering a dialogue and substantive collaboration and consultation. This would allow both communities and the GSWMA to concomitantly develop a much richer understanding of potential waste management solutions that are appropriately scaled for the island and island community context.

Grenadians, and especially the GSWMA, needs to prioritize the development of island-specific, island-driven, island-built solutions, using locally derived materials whenever possible. Too often, Grenada has imported technology for waste management, only to have it breakdown and fail. This leads to leading to costly repairs or a stagnant technology that sits there, idle, unable to be fixed, and becoming a wasted resource. The most recent example is that tyre shredder at Perseverance that was not working fully in 2018-2019[51]. Recent reports indicated that the tyre shredder remains non-functioning, and the GSWMA reported an accumulation of 60-80,000 tyres in the debris pile that are currently on fire (June 2021)[52].

[51] Time in which I was conducting field work in Grenada.
[52] Press conference from the GSWMA is available online at https://fb.watch/6jlM1W_1TB/

| Recommendations | | Preliminary indicators | Responsible parties | Financial implications |
|---|---|---|---|---|
| 5. Engage citizens and community groups in waste management planning, innovation, and implementation. | 5.1 Community-level initiatives | 5.1.1 Number of community liaisons.<br>5.1.1 Number of community waste management plans.<br>5.1.2 Number of community waste management projects.<br>5.1.3 Amount of funding allocated to participatory, community budgeting. | GSWMA and Ministry responsible for the Environment | Funding for community level planning and development. |
| 6. Improve available waste management infrastructure for citizens | 6.1 Increase opportunities to dispose of waste properly. | 6.1.1 Develop clear policy on public bin installation.<br>6.1.2 Number of transfer stations in areas of the country that allow for drop off.<br>6.1.3 Number of bins installed and managed by the GSWMA. | GSWMA, Ministry responsible for the Environment, Ministry of Health | Funding for infrastructure. |
| | 6.2 Increase opportunities to sort waste at household or commercial waste. | 6.2.1 Number of public consultations to develop waste diversion programs.<br>6.2.2 Amount of funding provided to community groups or private sector engaged in developing diversion programs | GSWMA, Ministry responsible for the Environment, Ministry of Health | Funding for infrastructure, public relations, and project funding. |
| 7. Increasing waste management education. | 7.1 Establish waste management content in the curriculum. | 7.1.1 Number of students educated in waste management. | Ministry of Education | Funding for curriculum development. |

Table 7.4 Recommendations for increasing public participation in waste management

## 7.4 Towards an island-appropriate circular economy

The circular economy (CE) may be one approach to ameliorating sociometabolic risk associated with waste management in Grenada. CE is an evolving concept that, in theory, reaches beyond incremental or end-of-pipe "solutions" to address product and material use from a systems level. A circular economy is both restorative and regenerative by design; it demands rethinking *waste* to implement a *resource focused* mindset. Yet, in practice, CE has yet to be realized, and to date, CE is often applied (rather, claimed application) and studied through functional 'end-of-pipe' responses (i.e., recycling, disposal) that do not address the root of the problem (Chapter 2). This is problematic, and therefore, I'd argue that governments need to be cautious about applying the term 'circular economy' without considering 'upstream' innovation and design. Several hierarchical strategies can be considered in implementing the circular economy (Potting et al., 2018, 2016). Table 7.5 lists these strategies, with existing or mentioned strategies from the results of this dissertation. These strategies must be considered in ranked order; in other words, refusing and rethinking should always be considered prior to remanufacturing and recycling.

At a practical level, it is helpful to think of a circular economy as two metabolisms: a biological metabolism of biodegradable materials and a technical metabolism of non-biodegradable materials (McDonough and Braungart, 2002). If non-biological materials enter the environment (e.g., a dumpsite, a park) or biological materials enter the technical metabolism (e.g., a landfill), there is a breakdown in the full metabolic potential of the resources. The two metabolisms are depicted in the Ellen MacArthur Foundations (EMF) system diagram which outlines loops or activities to minimise material leakage from both the economy/technical and nutrient cycles (Figure 2.2). The inner loops require the least amount of material and energy inputs to maintain the materials in the economy; this hierarchy of material use aligns with traditional waste hierarchy thinking (i.e., The 3Rs – Reduce, Reuse, Recycle) and a more expanded version of the 9R circular economy strategies outlined by Potting et al. (2016). In a circular economy, material throughput is reduced through a reduction of virgin material extraction, continuous cycling of resources in the economy, and a reduction (or absences) of waste generation and leakage into the environment.

| Strategy & definition | Existing examples of activities in Grenada - Results from the Dissertation | Ideas of activities from participants - Results from the Dissertation | Ideas for future implementation in Grenada |
|---|---|---|---|
| **Refuse:** Make products redundant through abandoning function or offering same function with different product. | Non-Biodegradable Waste Control Act banned importation of Styrofoam and handled shopping bags, leading to substitutions for biodegradable options. | Use of 'refill' models for products to refuse single use packaging. | Expansion of the Non-Biodegradable Waste Control Act.<br><br>Expansion of the Environmental Levy Act to reduce consumption |
| **Rethink:** Make product more intensive through sharing or multi-functional products | Public transit and taxi services providing transportation.<br><br>Sharing and intensification of existing housing/building stock. | | Expansion of the Environmental Levy Act to reduce consumption on problematic products and/or fund other circular economy strategies.<br><br>Car sharing outside of the tourism economy. |
| **Reduce:** Increased efficiency in manufacturing or consumption by consuming less materials and resources. | | Apply tipping fees and penalties for all ICI customers to encourage reduction in waste. | |
| **Reuse:** Reused by another consumer of the product that is discarded but product still maintains original function. | Deposit on beer bottles enables return and reuse. | Expansion of deposit system to other products, such as glass bottles used in food processing/ manufacturing in Grenada. | |
| **Repair:** Repair defective product to be used in original function. | | | Right to repair legislation |
| **Refurbish:** Restore old products to bring up to date based on functionality of new products | | | Right to repair legislation<br>Parts importation for upgrading |

| | | |
|---|---|---|
| **Remanufacture:** Utilized parts of old products for new products with different function. | | Processing used oil into diesel. |
| **Repurpose:** Use discarded product parts in new product with different function | Repurposing of tyres into flowerpots or embankments.<br><br>Cutting bottles into glassware. | |
| **Recycle:** Process materials for same (high grade) or lower (low grade) quality. | Shipping materials off-island for recycling. | |
| **Recover:** Incineration of materials for energy recovery and methane gas management in landfills | Burning of used motor oil in the former Protein from Waste plant. | |

Table 7.5 Existing and potential application of waste strategies in Grenada. Adapted from Potting et al. (2018, 2016)

In this dissertation, the circular economy is defined as an economy that permits biological materials to re-enter the nutrient cycles in the environment, while non-biological materials (i.e., plastics, metals) are continually circulated in an economy (Haas et al., 2015). This academically derived definition aligns with the popularized definitions from the Ellen MacArthur Foundation: a circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems (Ellen MacArthur Foundation, n.d.)

The circular economy is beginning to gain traction for small island states in the Caribbean, and a few initiatives are worth mentioning. In 2017, the Caribbean Waste Management Conference specifically identified the circular economy as a potential approach for waste management in small island states in the Caribbean (Luken, 2017). In 2020, the Global Environmental Facility (GEF) approved the project concept of a UNEP/Cartagena Convention project entitled '*Reduce marine plastics and plastic pollution in Latin American and Caribbean cities through a circular economy approach'*, which includes a number of policy and upstream actions to address the root causes of plastics pollution in the Caribbean seas (UNEP, n.d.). Another project, *'RePlast-OECS'* is plastic recycling pilot in St. Lucia, which will eventually be scaled up to other OECS countries. The project is advocating for a 'circular economy approach' through collecting plastic bottles and exporting them within the region for recycling. Residents are provided an incentive for collecting bottles; collectors are rewarded with points redeemable for products and discounts from market partners (UNITE Caribbean, n.d.).

On February 1st, 2021, the Circular Economy Coalition for Latin American and Caribbean was announced at a virtual side-event of the XXII Meeting of the Forum of Ministers of the Environment of the region. The formation of this coalition, and multiple projects in the region signals an appetite and opportunity for building the circular economy partnerships and networks in the region. Considering the COVID-19 public health crisis – which, has without a doubt, increase the ubiquity of plastic and disposable consumption – there is an urgency to shift to a sustainable waste management system that includes partial, island appropriate circularity.

For an island dependent on imports for food and basic needs, a circular economy may not realistically mean *island self-sufficiency*. For the foreseeable future (and, perhaps forever), Grenada will likely rely on outside of economies to supply several imported products and materials. It may also continue to rely on outside economies to accept materials for processing and recycling, due to economies of scale of island systems. Therefore, I suggest that *island-appropriate circular economy* calls for regional, national, and community-based approaches that strives for partial circularity at various

scales. Appropriate technology is aligned with the scale of impact and adapted for the island context; preferably, these approaches are developed *on the island, by islanders.* For example, at a community or national level, developing island-appropriate technology that is scalable, modular, repairable and uses local materials and expertise would have much greater success than an engineered solutions that are economically infeasible or require inaccessible expertise or parts to repair and adapt.

Recently, the GSWMA began selling black plastic composters for citizens to compost their organic waste on their property. Notably, it is a worthwhile to encourage household sorting and composting. But, at $400 EC per composter, this imported 'solution' is considerably out of reach for many GSWMA employees and citizens alike; this price equates to over two weeks of wages for some Grenadians[53]. Furthermore, it the composter was to break, it would become plastic waste in the dumpsite, as there are little means of repairing. Instead, a simple solution of building composter, such as the composter pictured in Figure 7.1 at Belmount Estate, seems more reasonable. A locally built composter is cost effective, repairable with materials on island, and uses locally grown materials, such as the invasive bamboo or an existing resource, like pallets from shipping. This illustrates that point that an *island-appropriate circular economy* looks inward for ideas and innovation – not externally to consultants or imported products.

Figure 7.1 Composter using pallets and local materials, October 29, 2018

[53] The Ministry of Labour publishes the Minimum Wage Order online for several professions, with minimum wages starting at from $35 EC/day for cleaners in industrial settings and bus conductors.

'Nature-based solutions' (NBS) may be one approach to implement CE while also establishing environmental protection and regeneration of ecosystem services. Both the IUCN and UNEP define NBS similarly as "actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits" (IUCN, 2016, p. xii; UNEP, n.d.). NBS can support a social metabolism that is both restorative, regenerative, promoting resource productivity and pollution avoidance (UNESCO, 2018). The main applications of NBS to municipal solid waste are anaerobic digestion, composting, and using organic waste and construction and demolition waste to create soil-like substrates or 'technical soils' (Atanasova et al., 2021; Kisser et al., 2020). The benefit of NBS is the delivery of co-benefits: providing waste management services (i.e., eliminating sources of pollution, such as methane gas leading to fires) and developing and regenerating ecosystem services, such as soil and compost inputs (Atanasova et al., 2021). It also further allows for Grenada to look inward at existing resources and practices for waste management solutions.

The circular economy provides a language, framing and potential funding source for future waste management in Grenada. But a CE will never be realized without establishing basic environmental protections, waste management governance and prioritizing citizen participation, key focuses of Chapter 5 and 6 of this dissertation. Consequently, in looking forward to the future of waste management in Grenada, the GSWMA needs to look inward for capabilities and resources to assist with waste management implementation.

This dissertation aimed to address the research question: **What opportunities exist for islands to sustainably manage their waste?** The research confirmed that the experiences, challenges, and opportunities of Grenada's waste management system are not unique. Like many small island states (Chapter 2), Grenada's waste management system is at a tipping point. It is neither environmentally tenable nor socially just to continue the current, linear path. Waste management challenges will not be ameliorated by increasing disposal capacity through building a new landfill or relying on the future possibility of incineration or waste-to-energy. These end-of-pipe responses fail to address the root cause of Grenada sociometabolic risk. Consequently, the government has a choice. It could continue to make incremental steps in improving waste management at the risk of continued threats to human and environmental health. Alternatively, the government could envision, develop, and most importantly *implement* a systems-based approach to resource management.

The government of Grenada has an opportunity to 'leap-frog' past technical approaches often touted by developed nations and project consultants and develop Grenadian-centered, island appropriate solution. The circular economy holds promise in balancing the drivers like economic prosperity, jobs, and basic needs, with environmental and social protections. Grenada could become the showcase of the Caribbean, truly living up to is moniker *Pure Grenada*

An island appropriate, circular economy is not a small undertaking. But it holds promise when held up to the numerous, failed attempts to improve waste management with technical fixes in Grenada to date. Grenada needs a 'paradigm shift' in how development, progress and human wellbeing are conceptualized (National Plan Secretariat, 2019) and a regenerative, island-specific, circular economy can do just that.

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*"Our country's progress awaits a paradigm shift in how we as citizens view ourselves; a shift away from a limitation toward opportunities and possibilities and a shift away from inaction toward solutions" (National Plan Secretariat, 2019, Pg. 2)*

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To be sure, this is not a project that is easily undertaken by a single island government with a limited tax-base and resources. However, a circular economy can be quite feasibly undertaken in the context of a regional Caribbean strategy where island states collaborate, pool their resources, and consider best how to use all materials as resources in a way that maximizes benefits for the overall region. Furthermore, islands can strive for partial circularity at the community level – prioritizing projects and initiatives that are championed by citizens and recognize citizen engagement as a critical piece to successful waste management and circular economy development.

The implementation of the circular economy needs to be supported by strong measures that ensure environmental protection and environmental justice. An island-designed circular economy is not a waste management system that just *less bad;* instead, it fosters human wellbeing, regenerates ecosystems, and generates economic prosperity through good jobs and sustainable and sufficient economy. An island circular economy implements strategies to keep resources in use through developing networks and economies working together. Looking toward to future research and implementation, it is up to the Grenadian government, with substantive input and guidance from citizens to investigate and action on solutions that work in Grenada.

The Ellen MacArthur Foundation (EMF) has produced a useful toolkit for policy makers that provides a step-by-step methodology for policy makers to follow in implementing the circular economy (Appendix 22), as well as a set of Universal Policy Goals for a circular economy (Appendix 23). The government of Grenada may find either of these guides to be useful in informing the circular economy process. This dissertation conducted extensive primary research to assesses the 'Baseline Circularity and Policy Landscape' (Step 1.1 in Appendix 22) in Grenada. The next steps are to *implement* by setting an ambition level, selecting sectors to focus – and, most importantly, engaging stakeholders throughout the process.

## 7.5 Future waste and sociometabolic research in Grenada

Typical of social-ecological and systems-based research, this dissertation highlights more questions than it does answers. Throughout the data collection and analysis process, I was always struck by the number of questions I had – and frustrated by my inability to answer these questions based on the data collected and my limitations as a sole PhD researcher. As this dissertation is exploratory, I find it pertinent that I outline a draft, future research agenda for continuity of social-ecological and sociometabolic research in the Grenadian context, which is summarized in Table 7.6.

First, Grenada would benefit from an economy-wide material account of the flows and stocks on the island. This dissertation contributes to an under-researched area of MFA: outflow accounting, but it does not provide a high-level overview of material flows of Grenada. Second, further research is required to understand material consumption at the household, individual and business levels. As outlined in Chapter 6, there is a desire to increase sorting behaviours and educational programs, but to date, there has not been any research on the means or effectiveness of these strategies. Third, more research is needed to adequately understand the best approaches for designing and implementing a collection system that recognizes the needs and habits of Grenadians (Chapter 6). Finally, from a resource management and environmental justice perspective, it is pertinent to understand current accumulation of waste stock, such as tyres, as well as remediation strategies for current dumpsites and dumping areas.

| Phase in waste management process | Topic of study | Example references |
|---|---|---|
| System-level | Economy-wide material account of flows and stocks. | Krausmann et al., 2014 |
| Consumption | Separation and sorting behaviors at the household level | Farley et al., 2019 |
| | Separation and sorting behaviors in tourism | Sealey and Smith, 2014 |
| | Impacts of tourism growth, population growth and waste generation. | Kapmeier and Gonçalves, 2018 |
| | Effectiveness of waste sensitization and public relations campaigns in reaching the public. | |
| | Promising practices in waste management education, both for adults and children. | |
| Collection | Promising practices in infrastructure development, transfer station development, public bin siting. | |
| Disposal | Accumulation of waste stock available for use, such as tyres and e-waste. | Sarkar et al., 2011 |
| | Remediation of existing dumpsites | |

Table 7.6 Draft research agenda for future Grenadian waste management research

While discussing technical capacity to implement projects, a participant of this study indicated a desire to develop a long-term connection – a partnership – between researchers and those implementing projects in Grenada, such as the line ministries (e.g., Ministry of Environment) (Participant 18). The island of Grenada would benefit greatly by forming a long-term partnership with researchers; ideally, researchers would be connected and committed to living and working in Grenada, with linkages to Grenada's tertiary educational institutes to form a joint research and teaching program. One example, Sustainable Samothoraki, has demonstrated the benefits of long-term, sociometabolic research project that includes multiple projects, research, and teaching focuses.

Sociometabolic research on islands can play a role in identifying and ameliorating compounding threats to island life: climate change, including extreme weather events and sea-level rise; economic shocks and import dependency; resource management, including 'waste' and pollution prevention; and other threats from connections to the global social-ecological system, including the COVID19 pandemic. Islands, including Grenada, need sustainability transformations that aligns with sociometabolic, island sustainability principles, suggested by Telesford and Strachan (2017) (Chapter 1) (summarized in Box 7.1). Implementation of these principles requires research on both the biophysical stocks and flows of society, as well as an understanding of the social-cultural system.

1. Island system must not be systematically subjected to increasing concentration of materials extracted from the earth's crust.
2. Island system must not be systematically subjected to increasing concentrations of materials created in society.
3. Island system must not be systematically subjected to degradation by physical means.
4. Island system must not be systematically subjected to conditions that undermine their capacity to meet

Box 7.1 Island sustainability principles, Telesford and Strachan (2017)

To date, the social-cultural aspects of the social metabolism framework are under researched, and my dissertation contributes to further understanding how governance systems and citizens influence material flows of waste. I am advocating for a continued research program in Grenada that takes a pragmatic, transdisciplinary approach to social metabolic waste: recognizing the importance of understanding biophysical flows, governance systems that guide those flows, and the perspective of citizens through field work.

## 7.6 Dissertation conclusion

Grenada has committed and made some important strides in working toward Agenda 2030 through the National Sustainable Development Plan 2020-2035. An *import-use-dispose* economy, however, will ultimately limit the Grenada's ability to achieve sustainable development and the sustainable development goals (SDGs). Sound, sustainable waste management, which prioritizes waste reduction, reuse, and diversion, is integral to all 17 of the SDGs (Figure 7.2). Without changes in Grenada's social metabolism, the sustainable development, the branding and reality of *Pure Grenada,* and the wellbeing of Grenadians is at risk.

The dumpsites (Perseverance and Dumfries), littering, and dumping all threaten the image of *Pure Grenada*. The spice isle's economy is dependent on a healthy environment and a strong, knowledgeable Grenadian workforce. Tourism is dependent on offering a *pure* environment: beautiful beaches, breath-taking landscapes, hikes, and waterfalls, and a rich cultural history. The tourist sector, especially growth and expansion outside of the southern region of Grenada, will not survive if the waste management system does not transition to a more sustainable model. Development of a blue, green and orange economy is all dependent on a sound, sustainable waste management system. Consequently, **the Grenadian government must increase investment in waste management, taking a systematic approach to addressing the root causes, governance**

**concerns and enhance public participation in the process.** In absence of changes to current waste accumulation, the waste management system is teetering on an environmental tipping point that threatens social, environmental, and economic health.


Figure 7.2 The connections between waste and the SDGs in Grenada.
Adapted from Leniewicz (2016) for the purposes of this dissertation.

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# Appendices

## Appendix 1: Literature Review Methods for Chapter 2

For each of the topics, a keyword search was conducted in Clarivate Analytics' Web of Science (hereafter, WoS). In the WoS database, literature was limited to research conducted in English and included only original research articles and review articles. The bibliographic details were exported, and network citation graphs were generated using the software VOSviewer (van Eck and Waltman, 2010). A set of criteria was developed to narrow the record collection to prominent and relevant literature in the networks: 1) Articles were included if they had a minimum number of citations in WoS, as selected based on the size of the network; 2) Articles were included if there were connected the main graph ('giant component') that included the majority of literature in the network. By filtering based on network characteristics (instead of article characteristics or researcher-determined relevancy), manual screening was avoided. This improved the processing time of the review while avoiding issues of interrater reliability, as this literature review is only conducted by the author of this dissertation. Furthermore, the review methods maintain the replicability of the literature review, allowing scholars to build off and update the work within Chapter 2 of this dissertation.

Table A.1 outlines the keywords, date of search in WoS, the number of articles in WoS returned based on the keywords, the minimum citations to be included in the review, the number of articles in the graph (with and without connection to the 'giant component'), and number of articles in the 'giant component' that were reviewed in this chapter.

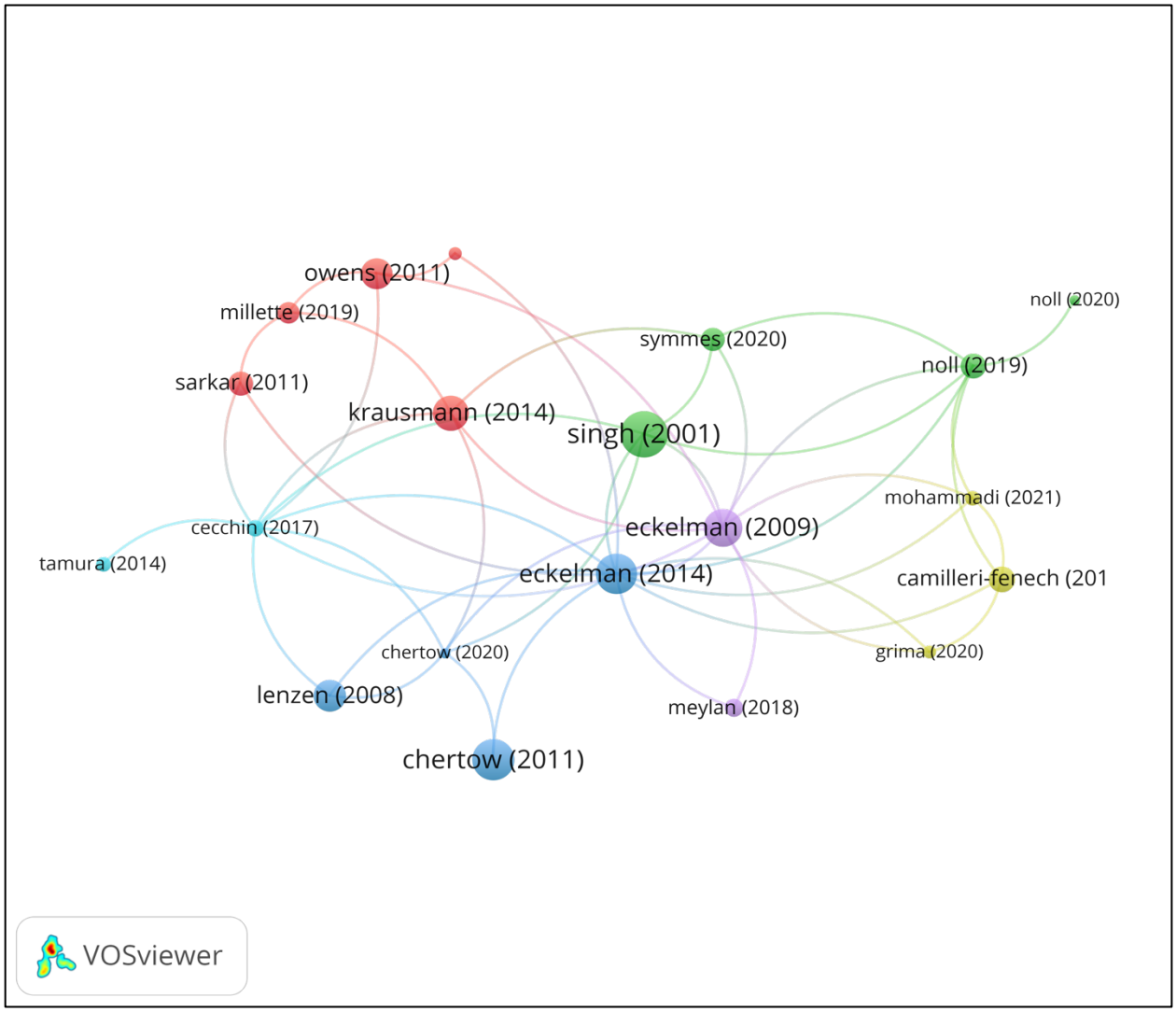
For the topic 'island metabolism', 8 articles from the special issue entitled *The Metabolism of Islands* published in the journal of Sustainability were included; this is in addition to the two articles from the special issue that were already included in the corpus (Chertow et al., 2020; Noll et al., 2020). These articles were included due to the clear topical relevance of this special issue. Additionally, a seminal article by Deschenes and Chertow (2004) that is not indexed in Web of Science was also included in this review; this article is widely cited in the existing network, as well as the special issue. Consequently, 20 articles appear in the citation graph, and an addition 9 were included (Appendix 2).

Based on this process, the sets of reviewed articles were considered an inexhaustive but adequate representation of the literature on the island metabolic studies, island metabolic studies and circular economy. A list of articles reviewed by topic is included in Appendix 2-4.

| Topic | Keywords | Date | Articles in WoS | Minimum citations | Articles in graph | Articles reviewed |
|---|---|---|---|---|---|---|
| Circular economy | "circular economy" | February 10, 2021 | 5746 | 200 | 30 | 24 |
| Island metabolism | (island OR "small island developing state") and ("social*metabolism" or "socio*metabolism" or "material flow" or "industrial*ecology" or "social*ecology" or "socio*ecology") NOT "heat island" | May 6, 2021 | 59 | 2 | 49 | 20 (+9) |
| Island waste management | (island OR "small island developing state") AND ("waste management" OR "municipal solid waste" OR MSW OR "solid waste" OR garbage OR "household waste" OR "domestic waste" OR "circular economy") | May 12, 2020 | 503 | 15 | 144 | 29 |

Table A1.1 Key word search in Web of Science and results of the citation network graphs

# Appendix 2: Island Metabolism literature reviewed in Chapter 2




**List of island metabolic literature reviewed**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23. Popescu, R., Beraud, H., Barroca, B., 2020. The impact of hurricane irma on the metabolism of St. Martin's Island. Sustain. 12. https://doi.org/10.3390/SU12176731
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25. Shah, K.U., Niles, K., Ali, S.H., Surroop, D., Jaggeshar, D., 2019. Plastics waste metabolism in a Petro-Island state: Towards solving a "wicked problem" in Trinidad and Tobago. Sustain. 11. https://doi.org/10.3390/su11236580
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28. Symmes, R., Fishman, T., Telesford, J.N., Singh, S.J., Tan, S.Y., De Kroon, K., 2019. The weight of islands: Leveraging Grenada's material stocks to adapt to climate change. J. Ind. Ecol. 24, 369–382. https://doi.org/10.1111/jiec.12853
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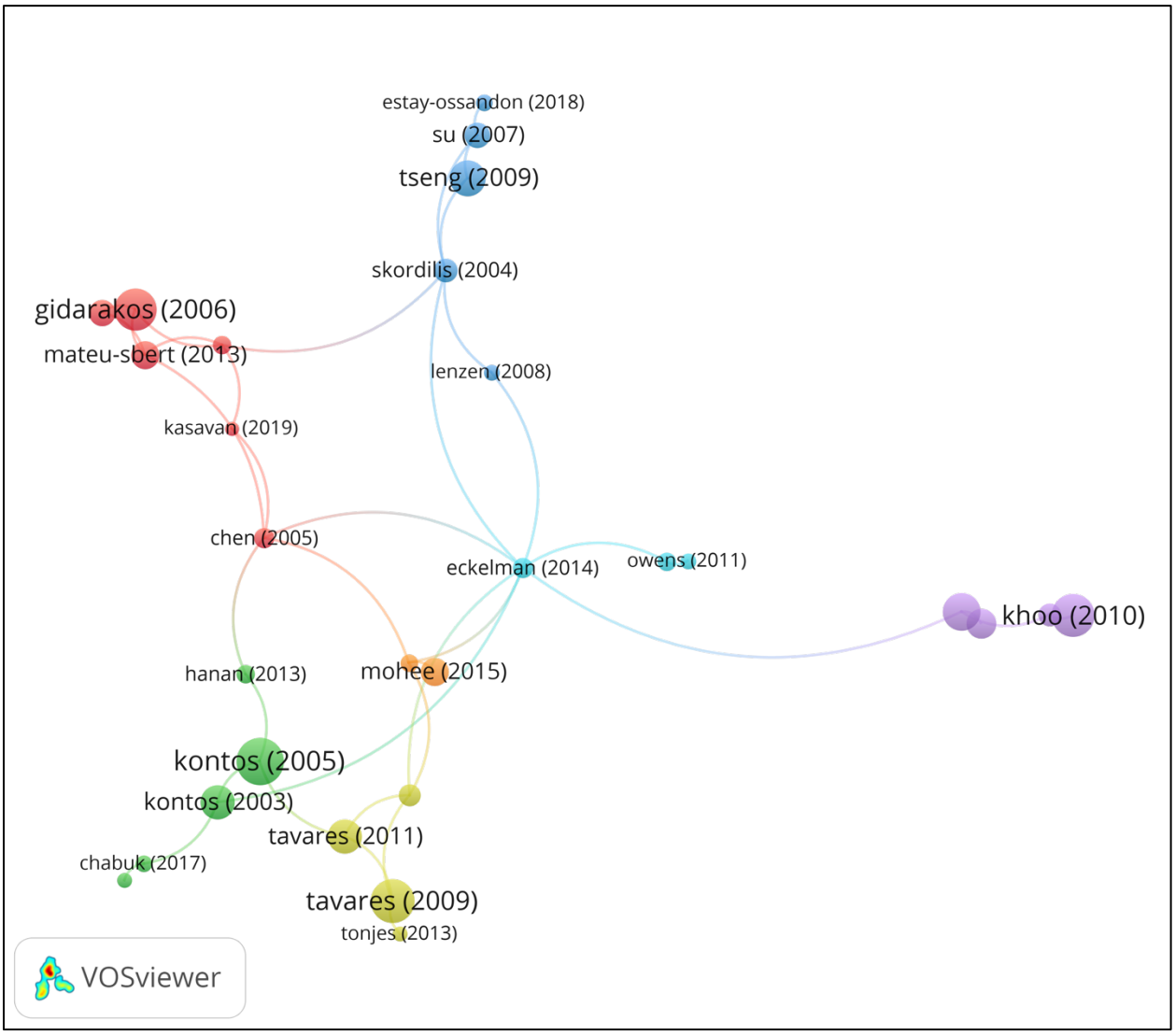
In addition to the corpus outlined above, additional island material and energy flow studies have contributed to the body of knowledge on island sociometabolism, particularly in the natural causation aspect of the framework through the application of industrial ecology methods. Select studies are briefly summarized in Table A2 as these works were either not returned with search parameters of the review (or are not indexed in WoS).

| **Reference** | **Summary** |
|---|---|
| Busch & Sakhel (2016) | Stores from Mangaia and Tikopia illustrate different forms of autarky. *Self-consuming autarky* is a system where resources are used until their supply erodes. *Self-preserving autarky* describes a strong sustainability situation where resources are used in ways that they can renew. "Island logic" can be scaled up to larger, social-ecological systems; but authors suggests that complex systems can and should be divided into sub-systems/organizational units (i.e., "islands) that balance resource flows within the boundaries that begin at the ground up to create small, closed loop systems. |
| Conrad & Cassar (2014) | Assessing the decoupling of economic growth from environmental degradation in Malta. Using statistical data, authors measure decoupling factors in four key sector 1) energy intensity, climate change, and air quality, 2) water, 3) waste, and 4) land. |

| | |
|---|---|
| Martinico-Perez et al., (2016) | Economy-wide material flow of the Philippines from 1985-2010, with IPAT analysis. Results indicate an increase in material consumption driven by population growth and affluence but highlight inequality in material consumption. |
| Sundkvist et al., (1999) | First island sociometabolic research according to Singh et al., (2020). Authors conducted a material and energy flow analysis on Nämdö, Sweden; quantification of primary and secondary production (i.e., natural and cultivated), human production, consumption and production of waste. Results demonstrate that the island carrying capacity is exceeded as only a minor amount of local resources are used, with most material and energy being imported. Authors suggest increase self-sufficiency through use of local resources and recycling. |
| West and Schandl (2013) | Estimate material use and material intensity in Latin America and the Caribbean from 1970 – 2008. Results indicate that the LAC region has a high material intensity (materials required to generation economic income), but this may be artificially high because the product or service is consumed outside the region, but waste and emissions remain. Researchers suggest that nations need to use natural resources more efficiently to generate more value per unit of resource. |

Table A2 Additional Island metabolism literature

# Appendix 3: Island Waste Management literature reviewed in Chapter 2




Appendix Figure 7.1 Citation network for island waste management

Appendix Figure 7.2 Citation network for island waste management

**List of island waste management literature reviewed**


1. Arbulú, I., Lozano, J., Rey-Maquieira, J., 2015. Tourism and solid waste generation in Europe: A panel data assessment of the Environmental Kuznets Curve. Waste Manag. 46, 628–636. https://doi.org/10.1016/j.wasman.2015.04.014
2. Bai, R., Sutanto, M., 2002. The Practice and Challenges of Solid Waste Management in Singapore. Waste Manag. 22, 557–567. https://doi.org/10.4236/jep.2010.14044

3. Chabuk, A., Al-Ansari, N., Hussain, H.M., Knutsson, S., Pusch, R., Laue, J., 2017. Combining GIS applications and method of multi-criteria decision-making (AHP) for landfill siting in Al-Hashimiyah Qadhaa, Babylon, Iraq. Sustain. 9. https://doi.org/10.3390/su9111932
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6. Eckelman, M.J., Chertow, M., 2009. Using material flow analysis to illuminate long-term waste management solutions in Oahu, Hawaii. J. Ind. Ecol. 13, 758–774. https://doi.org/10.1111/j.1530-9290.2009.00159.x
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9. Gidarakos, E., Havas, G., Ntzamilis, P., 2006. Municipal solid waste composition determination supporting the integrated solid waste management system in the island of Crete. Waste Manag. 26, 668–679. https://doi.org/10.1016/j.wasman.2005.07.018
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11. Jones, N., Evangelinos, K., Halvadakis, C.P., Iosifides, T., Sophoulis, C.M., 2010. Social factors influencing perceptions and willingness to pay for a market-based policy aiming on solid waste management. Resour. Conserv. Recycl. 54, 533–540. https://doi.org/10.1016/j.resconrec.2009.10.010
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13. Khoo, H.H., Lim, T.Z., Tan, R.B.H., 2010. Food waste conversion options in Singapore: Environmental impacts based on an LCA perspective. Sci. Total Environ. 408, 1367–1373. https://doi.org/10.1016/j.scitotenv.2009.10.072
14. Kontos, T.D., Komilis, D.P., Halvadakis, C.P., 2005. Siting MSW landfills with a spatial multiple criteria analysis methodology. Waste Manag. 25, 818–832. https://doi.org/10.1016/j.wasman.2005.04.002
15. Kontos, T.D., Komilis, D.P., Halvadakis, C.P., 2003. Siting MSW landfills on Lesvos Island with a GIS-based methodology. Waste Manag. Res. 21, 262–277. https://doi.org/10.1177/0734242X0302100310
16. Lenzen, M., 2008. Sustainable island businesses: a case study of Norfolk Island. J. Clean. Prod. 16, 2018–2035. https://doi.org/10.1016/j.jclepro.2008.02.006
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19. Owens, Zhang, Q., Mihelcic, J., 2011. Material flow analysis applied to household solid waste and marine litter on a small island developing state. J. Environ. … 137, 937–945. https://doi.org/10.1061/(ASCE)EE.1943-7870.0000399.
20. Ramjeawon, T., Beerachee, B., 2008. Site selection of sanitary landfills on the small island of Mauritius using the analytical hierarchy process multi-criteria method. Waste Manag. Res. 26, 439–447. https://doi.org/10.1177/0734242X07080758
21. Sealey, K.S., Smith, J., 2014. Recycling for small island tourism developments: Food waste composting at Sandals Emerald Bay, Exuma, Bahamas. Resour. Conserv. Recycl. 92, 25–37. https://doi.org/10.1016/j.resconrec.2014.08.008
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27. Tonjes, D.J., Mallikarjun, S., 2013. Cost effectiveness of recycling: A systems model. Waste Manag. 33, 2548–2556. https://doi.org/10.1016/j.wasman.2013.06.012
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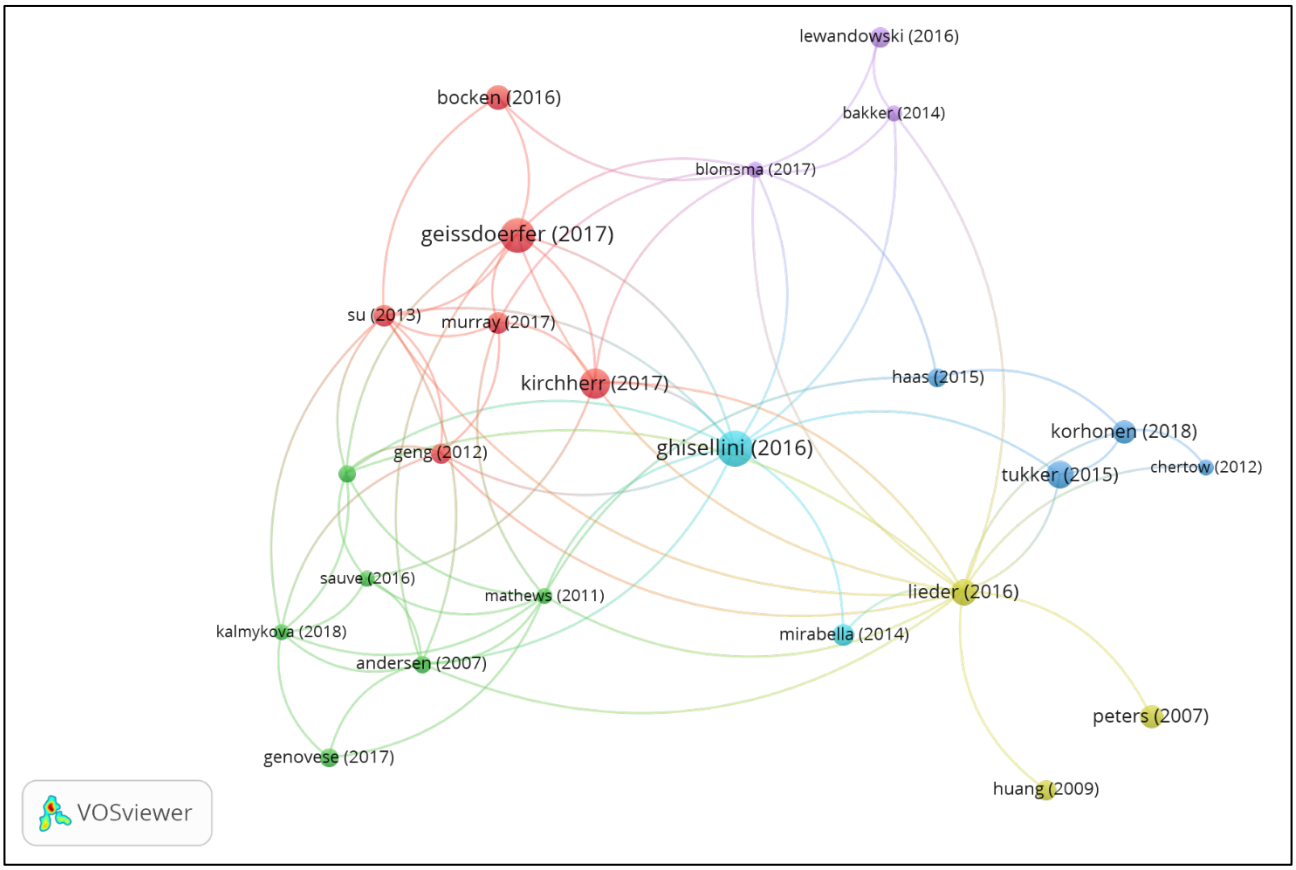
29. Zsigraiová, Z., Tavares, G., Semiao, V., Carvalho, M. de G., 2009. Integrated waste-to-energy conversion and waste transportation within island communities. Energy 34, 623–635. https://doi.org/10.1016/j.energy.2008.10.015

# Appendix 4: Circular economy literature reviewed in Chapter 2




Appendix Figure 7.3 Citation network for circular economy literature

Appendix Figure 7.4 Citation network for circular economy literature

**List of circular economy literature reviewed**


1. Andersen, M.S., 2007. An introductory note on the environmental economics of the circular economy 133–140. https://doi.org/10.1007/s11625-006-0013-6
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# Appendix 5: Information letter for informed consent process with expert interviewees

**Information letter for MFA interviews**

*Letter Seeking Informed Consent for Material-Flow Interviews*

Dear Potential Research Participant,

This letter is an invitation to consider participating in a research study I am conducting as part of my thesis-based PhD degree in the School of Environment, Resources and Sustainability at the University of Waterloo, Canada. This research is under the supervision of Dr. Simron Singh and in partnership with the Grenadian Solid Waste Management Authority (GSWMA). The study is titled *Leveraging Grenada's waste management system: sustainable development and resource circularity in the context of climate change.* The purpose of the study is to develop a robust system map to identify actions required for a sustainable waste system in Grenada. The data collected during the interviews will contribute to a better understanding of Grenada's waste management system, and future directions for sustainable development.

I would like to provide you with more information about this project and what your involvement would entail if you agree to participate as an expert research participant. In this interview, I request that you answer the questions from the perspective of an expert and professional within the confines of your current role. In the interview, I will ask you questions about the categories and quantities of waste present in Grenada's waste management system, as well as data sources that I may use for my study. For example, I am looking for public records on the amount of waste collected and disposed of in the landfill in order to understand the amount of materials generated and where these materials go. You will also be asked about the current structure of the waste management system, areas of concern, and prospects for the future of Grenadian waste management. Interview will commence immediately following the completion of this consent form. The entire process will take no more than one (1) hour and can take place at a public location of your choice.

Participation in this study is voluntary. You may decline to answer any question(s) you prefer not to answer by requesting to skip the question. Further, you may end the interview at any time by advising me of this decision. With your permission, the interview will be audio-recorded to facilitate collection of information, and later transcribed for analysis.

Within two months of the interview being completed, I will provide you a Follow-Up Letter that includes a copy of the transcription and summary of the key points to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points of our discussion. Please send me any amendments or clarifications of our recorded conversation within two weeks of receiving this Follow-Up Letter.

Once I have preliminary results of the study, with your permission I will re-contact you at a later date with additional information about participation in an Expert Focus Group Discussion where I will present my initial findings and collect feedback. Agreeing to be re-contacted now does not obligate you to participate and you can decide at that time. You are also invited to extend this invitation to other experts in the waste management field.

Your participation will be considered confidential. Identifying information will be removed from the data that is collected and stored separately. Your name will not be included in any paper or publication resulting from this study, however with your permission you will be referred to by your position title/affiliation and anonymous quotations may be used (e.g., 'GSWMA employee'; 'GSWMA Board Member'; 'Contract Employee' etc.). Alternatively, if you do not want to be referenced by your title/affiliation, you may choose to have your quotations referenced using only "confidential interview" instead. Collected data will be stored securely on University of Waterloo servers and in a locked office for a minimum of 10 years. You can withdraw your consent to participate and have your data destroyed by contacting me within this period. Please note that it will not be possible to withdraw consent once results have been submitted for publication. Only the researcher will have access to identifying information. The dataset without identifiers may be shared publicly, however your identity will remain confidential. All records will be destroyed according to University of Waterloo Policy.

Given the focus of the study and the particular groups of individuals involved, it is possible that others may be able to identify your involvement even with the use of anonymous quotations. These risks will be mitigated by ensuring you that you may decline to answer any questions that you do not have the right to disclose. Please remember that participation is voluntary and you do not have to answer any questions that you do not want to answer. Additionally, you will have the opportunity to review your comments before they are used in study results. Only the preliminary and final results of the study will be shared with the GSWMA. The GSWMA will not be informed about who participates in the study.

There is no intended commercial application of these results, and there is no conflict of interest from myself or the University of Waterloo. Please be advised, however, that Dr. John Telesford, a member of the GSWMA Board of Directors is also a member of my dissertation committee. Any potential for conflict of interest between Dr Telesford and the research project will be mitigated through the maintenance of confidentiality and anonymity of your data. Dr. John Telesford will only have access to data without personal identifiers.

If you have any questions about this study, or would like additional information, please feel free to address with me prior to commencing the interview. Also, for your reference, my contact information is listed below. You may also contact my advisor, Simron Singh, at ssingh@uwaterloo.ca or 1 (519) 888-4567 x 33111.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I hope that the results of my study will be of benefit to the Grenada Solid Waste Management Authority and the people of Grenada. I look forward to speaking with you and thank you in advance for your assistance in this research project.

Sincerely,

Allison Elgie
PhD Candidate
School of Environment, Resources and Sustainability

University of Waterloo, Canada
Waterloo, Ontario, Canada
aelgie@uwaterloo.ca
Grenadian mobile: 410-4056
WhatsApp: 519-807-4056

## Appendix 6: Consent form for MFA Expert interviews

**CONSENT FORM FOR MATERIAL FLOW ANALYSIS INTERVIEWS**

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about a study being conducted by Allison Elgie of the School of Environment, Resources and Sustainability at the University of Waterloo in Canada. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I have been advised that I may contact the researcher with any concerns I may have at aelgie@uwaterloo.ca, 1-519-807-4056 or at the local Grenadian phone number of 473-410-4056. I may also contact the researcher's supervisor, Dr. Simron Singh, at ssingh@uwaterloo.ca or 1 (519) 888-4567 x 33111

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am also aware that excerpts from the interview may be included in papers and publications to come from this research, with the understanding that the quotations will be anonymous and that I can choose to be referenced by my position title/affiliation (e.g., 'GSWMA management' etc.). I was informed that participation is voluntary and that I may withdraw my consent by advising the researcher up until results are submitted for publication. I understand that I will have the opportunity to review my interview transcripts before my data is used in papers and publications resulting from this research.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.
☐YES ☐NO

I agree to have my interview audio recorded.
☐YES ☐NO

I agree to the use of anonymous quotations in any paper or publication that comes of this research.
☐YES ☐NO

I also agree to be referenced by my position title/affiliation, such as: ☐GSWMA Management ☐ GSWMA Employee ☐ GSWMA Board Member ☐ Contractor Employee ☐ Other (please indicate):_____.

I have been informed that I will be invited to attend a Focus Group at a later date where the results of the study will be presented, and I consent to being contacted about the Focus Group knowing that I am under no obligation to attend.
☐YES ☐NO

Participant Name (print): _____
Participant Signature:_____

Witness Name (print): _____
Witness Signature: _____

Date: _____ Interview no. _____

## Appendix 7: Material Flows Interview Protocol

*(following the reading and signing of Letter of Consent)*

| Topic | Grand Tour Questions | Probing Questions | Approximate time for each question |
|---|---|---|---|
| Introductions | *Verbal Script:*<br>First of all, thank-you [insert name] for taking the time to answer my questions today. I hope that this can be a reciprocal process where we both feel like we learn something today. Just to give you a bit of an outline of how I have structured this interview…I am using a 'semi-structured' process, which means that I have outline some key questions that I would like to understand – but aside from that, this is a conversation. We will start off with talking about your position at the [insert company] and some of your responsibilities, I'll give you a brief explanation of the measurement process that I am using and explain it and then we can chat about using this method in Grenada. Of course, at any point along the way, please feel free to ask me questions as well. It's my hope that this is very much a conversation. Is there anything that I can clarify? | | 2 mins |
| Questions related to understanding expertise and responsibilities. | What is your role at the GSWMA (or other organization)? | What department is your role in? [Appendix 6]<br>Did you have any previous roles?<br>How long have you been in this role? | 5 mins |
| | What are your responsibilities? | What does your office do?<br>What is your official or unofficial mandate?<br>What responsibilities does your team have?<br>What resources does your department or team control? | 5 mins |
| Questions related to the key challenges associated with their responsibilities. | What are some of the key challenges or barriers of achieving your mandate or responsibilities? | In your role, what are challenges?<br>If your mandate is _____, is there anything preventing you from doing that? | 5 mins |
| Providing information to the participant about Material Flow Analysis, its usefulness and interesting existing studies | *Verbal Script:*<br>*(using the diagram in Material Flow diagram)*<br><br>I am using what is called a Material Flow Analysis to look at waste in Grenada. I define waste as "any material or object the holder discards or intends to discard". Of course, everyone (and I mean everyone!) produces waste. On islands like Grenada, it happens to be easier to measure waste. And a material flows study emphasizes that "you can't manage what you can't measure". | | 5 mins |

| | | | |
|---|---|---|---|
| | I view waste as both a natural/ecological and social challenge. If we look at the outflows of waste, we can learn a lot of interesting things about the environmental impacts of materials on Grenada's social and environmental system.<br><br>Material flow accounting measures the quantity and quality of material and energy domestically produced, imported, transformed, used, and discarded. So, for example (*referring to diagram)* we can see in this diagram that WASTE is dependent on materials entering the Grenadian system either through IMPORTS or DOMESTIC EXTRACTION. WASTE can end up in two locations – either deposited domestically in Grenada – in the Perseverance landfill for example or informally – or waste (material *stuff*) can be exported off the islands.<br><br>Material flow accounting methods have been used on several islands to measure the material impact of waste materials. For example, my advisor at the University of Waterloo in Canada demonstrated on Trinket Island (which is an island in India) that the decomposition of waste has changed from biological or compostable materials to materials based on fossil fuels like plastics. Another Caribbean study in Dominica demonstrated the challenge that islands have with tire disposals because shredding and repurposing tires at a smaller scale can be quite uneconomical. Additionally, John Telesford, whom you may know from the GSWMA, has conducted a tourism-sector material and energy flow analysis in Grenada, and my work will be a continuation of this.<br><br>This research helpful for policy makers working towards sustainable development *if it is context specific.* The limitation of this research, however, is that only material inputs and outputs are considered; the social, economic and cultural processes are a 'black box' within this framework, and therefore the second half of my study will be looking at sociocultural and pollical processes that guide the flow of materials because materials *do not flow on their own.* Culture – including governing systems and institutions – regulates the environmental flows in order for the social-ecological system to continue to reproduce itself over time. There is a need to understand the ways in which governance, institutional arrangements and policies impact the stocks, inflows and outflows.<br><br>Do you have any questions about this framework or my brief explanation of Material Flow accounting? | | |
| Questions based on the type of documentation and data that is available. | What kind of documentation does your department or team maintain related to waste materials? | For example, based on your mandate _____, do you maintain _____ (documentation)?<br>What kind of data do you collect within your department? | 10 mins |

| | | | |
|---|---|---|---|
| | Is this data publicly available? | Where is the data published?<br>Can I gain access to the data?<br>Who do I need to ask about getting access to _____ (database/records)? | 5 mins |
| Questions about existing research on waste in Grenada. | Has there been any other waste studies on Grenada that have been conducted? | For example, what are the preliminary results of the ISWM study?<br>Is there are waste characterization study being conducted in the ISWM project? | 5 mins |
| Questions about challenges with *current* waste management system | What are some of the major or birds-eye, high level challenges faced by the GSWMA or [insert name of company] *right now*? | What is an urgent challenge for people working in waste management in Grenada? | 5 min |
| Questions about *future* waste management system | *Verbal Script:* So, given that you outlined [insert challenge] as an urgent challenge, keeping this in mind, I'd like to talk about the future of Grenada's waste management system. | | |
| | From a bird's eye view, what do you imagine a *future* waste management system in Grenada looking like? How would this future system alleviate challenges with _____? | | 5 mins |
| Questions and providing information to the participant about the circular economy and resource circularity | Have you heard about the concept of the circular economy? | Have you heard about the idea of thinking about waste as a resource? | 5 mins |
| | *Verbal Script: (using Examples of Circular Economy as a tool)* The circular economy is a relatively new concept in waste management. It suggests that we should design waste OUT of the system, and begin to treat waste as a resource to be used. It means better designing products so that they can be repaired. And when products need to be replaced, they can be easily deconstructed and reuse the materials in order for materials to maintain a high quality through a continued life cycle.<br><br>The Circular Economy was a major topic at that Caribbean Waste Management Conference in 2017. | | |
| | Do you have any other information that you'd like to share or that you think would be helpful in this project? | Any other resources, publications or documentation? | 5 min |
| | I have gaps in data regarding [insert material categories]. Do you know who may have information that covers _____? | | |

| | | | |
|---|---|---|---|
| | | | |
| | Who do you know that would be helpful in providing more information about waste management in Grenada? | Can you introduce me via email/phone?<br>It's helpful if you are able to introduce me, as this protects their privacy as well as increases the chances that they will be interested in answering my questions. | |

# Appendix 8: Information letter and statement of implied consent for FG participation

*Information letter and statement of implied consent for Focus Group participant*

Dear Focus Group participant,

I am conducting as part of my thesis-based PhD degree in the School of Environment, Resources and Sustainability at the University of Waterloo in Canada. This research is under the supervision of Dr. Simron Singh and in partnership with the Grenadian Solid Waste Management Authority (GSWMA). The study is entitled: *Leveraging Grenada's waste management system: sustainable development and resource circularity in the context of climate change*. The purpose of the study is to develop a robust system map to identify actions required for a sustainable waste system in Grenada. The data collected during this Focus Group will contribute to a better understanding of Grenada's waste management system, and future directions for sustainable development.

I have preliminary results of the study based on my interviews with experts from the GSWMA and other companies. This letter serves as an invitation to invite you to hear and comment on the preliminary results in a Focus Group session. The purpose of this Focus Group is to present these results to the waste management community and gather feedback. The session will consist of approximately a half hour of presentation of the results and a half hour of discussion guided by questions from the researcher about the waste categories and quantities calculated by the study to date. The entire session will be a one (1) hour commitment. The purpose of soliciting feedback is to ensure the accuracy of the findings to date, and to gain your valued perspective on the research. The focus group session will be audio-recorded to facilitate the collection of information and later transcribed for analysis. Anonymous quotations from the transcript may be used in papers and publications resulting from this study and participants will be referenced only as "Focus Group Participant

Participation in this session is completely voluntary. You may decline answering any questions you feel you do not wish to answer and you may leave the session at any time. Please note that due to the group format of the session and the fact that identifying information will not be collected, it will not be possible to withdraw your participation once the session ends because the researcher will not be able to verify which data belongs to you. Given the group format of this session I will ask you to keep in confidence information that identifies or could potentially identify a participant and/or their comments. However, I cannot guarantee that all participants will honour this request.

The dataset without identifiers may be shared publicly; however, your identity will remain confidential and your name will not appear in papers and publications resulting from this study. Collected data will be stored securely on University of Waterloo servers and in a locked office for a minimum of 10 years. All records will be destroyed according to University of Waterloo Policy.

Please remember that participation is voluntary, and you do not have to answer any questions that you do not want to answer or do not have the authority to disclose. Given the focus of the study and the particular groups of individuals involved, it is possible that others may be able to identify your involvement even with the use of anonymous quotations. Furthermore, only the preliminary

and final results of the study will be shared with the GSWMA. The GSWMA will not be informed about who participates in the study or have access to raw data collected during this focus group.

There is no intended commercial application of these results, and there is no conflict of interest from myself or the University of Waterloo. Please be advised, however, that Dr. John Telesford, a member of the GSWMA Board of Directors is also a member of my dissertation committee. Any potential for conflict of interest between Dr. Telesford and the research project will be mitigated through the maintenance of confidentiality and anonymity of your data. Dr. John Telesford will only have access to data without personal identifiers.

**Statement of implied consent:** Attending and participating in the audio-recorded Focus Group session implies your consent to participate as a research participant and for the use of your contributions in papers and publications resulting from this study. By participating in the research, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities

If after receiving this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about Focus Group participation, please feel free to contact me. My contact information is listed below. You may also contact my advisor, Simron Singh, at ssingh@uwaterloo.ca or 1 (519) 888-4567 x 33111.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I hope that the results of my study will be of benefit to the Grenada Solid Waste Management Authority and the people of Grenada. I look forward to speaking with you and thank you in advance for your assistance in this research project.

Sincerely,

Allison Elgie
PhD Candidate
School of Environment, Resources and Sustainability
University of Waterloo, Canada
Waterloo, Ontario, Canada
aelgie@uwaterloo.ca
Grenadian mobile: 410-4056
WhatsApp: 519-807-405

# Appendix 9: Citizens focus groups – Online recruitment

## Recruitment posts for social media

A research study on waste management in Grenada is seeking group interview participants for a discussion on March 20th and 27th in Saint Georges. Participants will be asked about their perspectives on waste through rough sketching and interview questions. Please contact Allison Elgie at aelgie@uwaterloo.ca or 473-410-4056 or WhatsApp 519-807-4056 if you'd like more information on participation. The study is called *Leveraging Grenada's waste management system: sustainable development and resource circularity in the context of climate change,* and is conducted by a PhD student from the University of Waterloo in Canada

### Facebook

Post body: The study *Leveraging Grenada's waste management system: sustainable development and resource circularity in the context of climate change* research project conducted by PhD student from the University of Waterloo in Canada is seeking participants for the study. Participants will be asked about their perspectives on waste through rough sketching and interview questions. Participants have the option of participating in a group or individual interview. Please contact Allison Elgie at aelgie@uwaterloo.ca or 473-410-4056 if you'd like more information on participation.

## Appendix 10: Recruitment Poster for Rich Picture Interviews and citizen focus groups

**School of Environment, Resources and Sustainability**

**University of Waterloo, Canada**

# PARTICIPANTS NEEDED FOR RESEARCH ON GRENADA'S SOLID WASTE MANAGEMENT SYSTEM

I am looking for volunteers to take part in a study on *Grenada's solid waste management system.* This study is in partnership with the Grenadian Solid Waste Management Authority. The purpose of the study is to develop a robust understanding of Grenada's waste management system to identify actions required for a sustainable waste system.

No special knowledge or expertise is required to participate, but you must be 18 years of age or older.

As a participant, you will be asked to participate in one session that will take approximately one (1) hour of your time. **You may choose to participate in a Group Session or Individual Session.** During the session, you will be asked to draw/sketch three pictures of Grenada's waste management system and answer some interview questions that will focus on Grenada's ideal, current and future waste management system.

For more information about this study or to volunteer for this study, please contact:

*Allison Elgie*

at

Email: *aelgie@uwaterloo.ca*

Phone: 473-*410-4056*

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

**Research study on waste management**
Contact Allison Elgie
Email: aelgie@uwaterloo.ca
Phone: 410-4056

## Appendix 11: Citizens focus groups information letter

*Information letter and statement of implied consent for Focus Group participants*

Dear Focus Group participant,

I am conducting research as part of my thesis-based PhD degree in the School of Environment, Resources and Sustainability at the University of Waterloo in Canada. This research is under the supervision of Dr. Simron Singh and in partnership with the Grenadian Solid Waste Management Authority (GSWMA). The study is entitled: *Leveraging Grenada's waste management system: sustainable development and resource circularity in the context of climate change*. The purpose of the study is to develop a robust system map to identify actions required for a sustainable waste system in Grenada. The data collected during this Focus Group will contribute to a better understanding of Grenada's waste management system, and future directions for sustainable development.

In this Focus Group, you will be divided into a group of 3-4 people. I will ask you as a group to discuss and draw/sketch on paper the current, ideal, and future waste management system in Grenada. As a group, you may draw whatever you think is important in your waste management system. A *waste management system* refers to *anything* that impacts the waste, recycling etc. that you or people in Grenada produce. For example, you may draw where you drop your waste off at and where it goes afterwards. The purpose of this is to understand how people interact with the waste management system and to understand your ideas and concerns. You are not required to have any drawing skills to complete this task, and I can provide prompts if necessary. Finally, as a group, you will be asked a series of questions about Grenada's waste management system through referencing your group drawings. The questions will focus on what your group drew for the ideal, current and future waste management system. The entire process will take no more than one (1) hour.

The focus group session will be audio-recorded to facilitate the collection of information and later transcribed for analysis. Anonymous quotations from the transcript may be used in papers and publications resulting from this study and participants will be referenced only as "Focus Group Participant

Participation in this session is completely voluntary. You may decline answering any questions you feel you do not wish to answer, and you may leave the session at any time. Please note that due to the group format of the session and the fact that identifying information will not be collected, it will not be possible to withdraw your participation once the session ends because the researcher will not be able to verify which data or statements belong to you. Given the group format of this session I will ask you to keep in confidence information that identifies or could potentially identify a participant and/or their comments. However, I cannot guarantee that all participants will honour this request.

The dataset without identifiers may be shared publicly; however, your identity will remain confidential, and your name will not appear in papers and publications resulting from this study. Collected data will be stored securely on University of Waterloo servers and in a locked office for a minimum of 10 years. All records will be destroyed according to University of Waterloo Policy.

There is no intended commercial application of these results, and there is no conflict of interest from myself or the University of Waterloo. Please be advised, however, that Dr. John Telesford, a

member of the GSWMA Board of Directors is also a member of my dissertation committee. Any potential for conflict of interest between Dr. Telesford and the research project will be mitigated through the maintenance of confidentiality and anonymity of your data. Dr. John Telesford will only have access to data without personal identifiers.

**Statement of implied consent:** Attending and participating in the audio-recorded Focus Group session implies your consent to participate as a research participant and for the use of your contributions in papers and publications resulting from this study. You understand that copies of your group drawings and excerpts from the group discussion may be used in papers and publications resulting from this research. You and your groups contributions will be anonymous and will be referred to as a Focus Group participant and Parish of the Focus Group location (e.g., Focus Group, St. Georges). By participating in the research, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

If after receiving this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about Focus Group participation, please feel free to contact me. My contact information is listed below. You may also contact my advisor, Simron Singh, at ssingh@uwaterloo.ca or 1 (519) 888-4567 x 33111.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I hope that the results of my study will be of benefit to the Grenada Solid Waste Management Authority and the people of Grenada. I look forward to speaking with you and thank you in advance for your assistance in this research project.

Sincerely,

Allison Elgie
PhD Candidate
School of Environment, Resources and Sustainability
University of Waterloo, Canada
Waterloo, Ontario, Canada
aelgie@uwaterloo.ca
Grenadian mobile: 473-410-4056
WhatsApp: 519-807-4056

## Appendix 12: Information letter for rich picture and interviews

*Information letter for potential interview participants*

Dear potential interview participant,

This letter is an invitation to consider participating in a research study I am conducting as part of my thesis-based PhD degree in the School of Environment, Resources and Sustainability at the University of Waterloo, Canada. This research is under the supervision of Dr. Simron Singh and in partnership with the Grenadian Solid Waste Management Authority (GSWMA). The name of the study is *Leveraging Grenada's waste management system: sustainable development and resource circularity in the context of climate change*. The purpose of the study is to develop a robust understanding of Grenada's waste management system to identify actions required for a sustainable waste system. To develop this robust understanding, I am seeking to interview citizens from all Parishes in the main island of Grenada

Participation in this study is voluntary. Prior to the interview, you will be asked to complete a participant information sheet capturing demographic information (i.e., gender, age, parish of residence etc.). This is to understand how different groups of people have different opinions and perceptions of waste management. You may decline to answer any or all of the questions on this sheet.

Following the completion of the participant information sheet, I will ask you draw/sketch on paper the current, ideal, and future waste management system in Grenada. You may draw whatever you think is important in your waste management system – by waste management system, I mean *anything* that impacts the waste, recycling etc. that you produce. For example, you may draw where you drop your waste off at and where it goes afterwards. The purpose of this is to understand how *you* interact with the waste management system and to understand your ideas and concerns. You are not required to have any drawing skills to complete this task, and I can provide prompts if necessary. Finally, you will be asked a series of questions about Grenada's waste management system in an in-person interview referencing your drawings. Interview questions will focus on what you drew for the ideal, current and future waste management system All of the activities will take place immediately following the completion of this consent form. The entire process will take no more than one (1) hour.

You may decline to draw any pictures and you may decline to answer any of the questions if you so wish. Further, you may decide to end the study session at any time by advising me of this decision. With your permission, the interview will be audio recorded to facilitate collection of information, and later transcribed for analysis. Additionally, with your permission I will keep your drawings for analysis, however if you prefer to keep the pictures I will make a digital copy instead.

Within two months of the interview being completed, I will provide you a copy of the transcript (either via email or in person) as well as a digital copy of your pictures to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points of our discussion. Upon receipt of the transcription and pictures, you will have two weeks to provide amendments or clarifications of our recorded conversation and/or drawing. If I do not hear back from you within two weeks, I will assume you do not object anything.

Your participation will be confidential. Identifying information will be removed from the data that is collected and stored separately. Your name will not be included in any paper or publication resulting from this study, however with your permission anonymous quotations and copies of your drawings may be used. If you consent to your data being used, you will only be referred to by your parish of residence and GSWMA collection zone number (e.g., 'Resident of St. Patrick, Zone 4'). Collected data will be stored securely on University of Waterloo servers and in a locked office for a minimum of 10 years. You can withdraw your consent to participate and have your data destroyed by contacting me within this period. Please note that it will not be possible to withdraw consent once results have been submitted for publication. Only the researcher will have access to identifying information. The dataset without identifiers may be shared publicly; however, your identity will remain confidential. All records will be destroyed according to University of Waterloo Policy.

Involvement in this interview is entirely voluntary and there are no known or anticipated risks to participation in this study. Please remember you do not have to answer any questions that you do not want to answer. Additionally, you will have the opportunity to review your comments before they are used in study results. There is no commercial application of these results, and there is no conflict of interest from myself or the University of Waterloo.

If after receiving this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact me. My contact information is listed below. You may also contact my advisor, Simron Singh, at ssingh@uwaterloo.ca or 1 (519) 888-4567 x 33111.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I hope that the results of my study will be of benefit to the Grenada Solid Waste Management Authority and the people of Grenada. I look forward to speaking with you and thank you in advance for your assistance in this research project.

Sincerely,

Allison Elgie
PhD Candidate
School of Environment, Resources and Sustainability
University of Waterloo, Canada
Waterloo, Ontario, Canada
aelgie@uwaterloo.ca
Grenadian mobile: 410-4056
WhatsApp: 519-807-4056

## Appendix 13: Consent for rich picture and interviews

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about a study being conducted by Allison Elgie of the School of Environment, Resources and Sustainability at the University of Waterloo in Canada. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I have been advised that I may contact the researcher with any concerns I may have at aelgie@uwaterloo.ca, 1-519-807-4056 or at the local Grenadian phone number of 410-4056. I may also contact the researcher's supervisor, Dr. Simron Singh, at ssingh@uwaterloo.ca or 1 (519) 888-4567 x 33111.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am aware that with my permission, copies of my drawings and excerpts from the interview may be used in papers and publications resulting from this research. I understand that my contributions will be anonymous and that I will only be referred to by my parish of residence and GSWMA collection zone number (e.g., 'Resident of St. Patrick, Zone 4'). I understand that I will have the opportunity to review my drawings and interview transcripts before my data is used in papers and publications resulting from this research, I am aware that upon receipt of these photos and transcription, I will have two weeks to provide comments or clarifications. I was informed that participation is voluntary and that I may withdraw my consent by advising the researcher up until results are submitted for publication.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#23255). If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.
☐YES ☐NO

I agree to have my interview audio recorded.
☐YES ☐NO

I agree to the use of anonymous quotations in any paper or publication that comes of this research (e.g., 'Resident of St. Patrick, Zone 4')."
☐YES ☐NO

I agree to the use of my drawings in any paper or publication that comes of this research.
☐YES ☐NO

I prefer that researcher creates a digital copy of my drawings so that I may keep the originals.
☐YES ☐NO

Preferred method of contact for receiving transcript and summary of our conversation
☐EMAIL ☐MAIL ☐ I do not wish to be contacted again (decline to provide address below).

Provide your emailing or mailing address:

Participant Name (print): _____ Participant Signature: _____

Witness Name (print): _____ Witness Signature: _____

Date: _____ Interview no. _____

## Appendix 14: Participant Information Sheet for Citizen Interviews

**PARTICIPANT INFORMATION SHEET**

Interview no. _____

*You are not obligated to answer any of the information questions below and may skip any question that you do not want to answer without penalty.*

1. What is your occupation?

2. Age (please circle)

| | | | | | | |
|---|---|---|---|---|---|---|
| 18-29 years | 30-39 years | 40-49 years | 50-59 years | 60-69 years | 70+ years | Prefer not to say |

3. Gender (please circle)

| | | | |
|---|---|---|---|
| Female | Male | Other | Prefer not to say |

4. Highest education level attained (please circle)

| | | | | | |
|---|---|---|---|---|---|
| No formal education | Primary education | Secondary education | Post-secondary education | Graduate or post-graduate education | Prefer not to say |

5. Citizenship (please circle)

| | | |
|---|---|---|
| Grenadian citizenship | International citizenship | Prefer not to say |

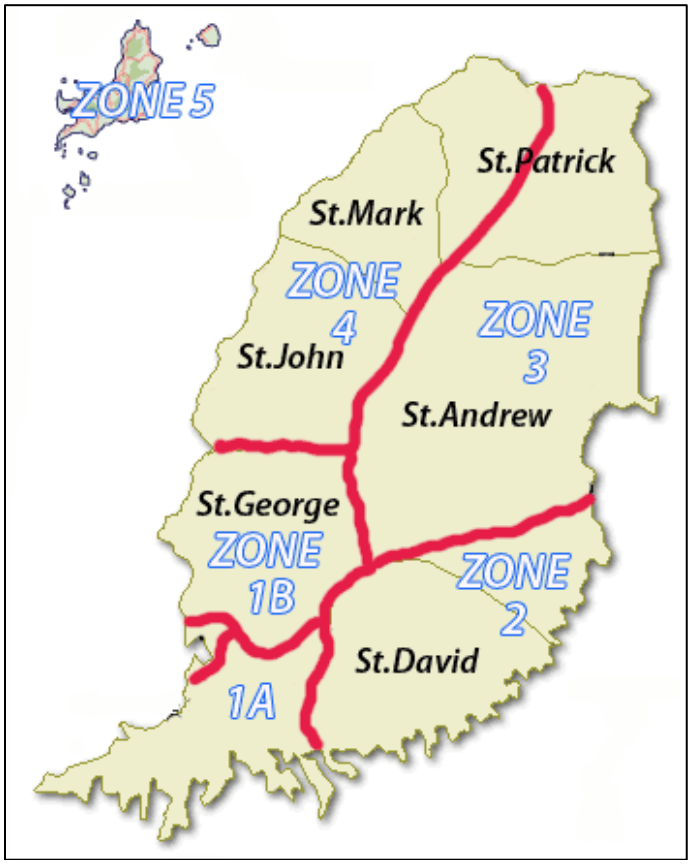
6. Parish or island of primary residence (please circle)

| St. Andrew | St. David | St. George | St. John | St. Mark | St. Patrick | Carriacou | Petite Martinique | Prefer not to say |
|---|---|---|---|---|---|---|---|---|

7. GSWMA Collection zone of primary residence (please circle, see back of sheet for reference map)

| 1A | 1B | 2 | 3 | 4 | 5 | Prefer not to say |
|---|---|---|---|---|---|---|

**COLLECTION ZONES OF PRIMARY RESIDENCE**



# Appendix 15: Rich Pictures protocol

### Verbal instructions

"As part of the interview to understand your perceptions and understandings of the waste management system, I'd like for you to draw three pictures of what the waste management system looks like to you. By waste management system, I mean *anything* that impacts the waste, recycling etc. that you or your family or your workplace produces. For example, you may draw where you drop your waste off at and where it goes afterwards.

You are welcome to draw anyway that you like – you can use elaborate pictures or simple arrows and boxes – it really doesn't matter. For each picture, I'll read you a prompt and hand out a piece of paper with the prompt written on it as well. You are welcome to ask any clarifying questions at any time. You can use any of the supplies we have here, and you are most welcome to more paper as well. As I indicated in the consent form, you are under no obligation to complete this activity – it won't impact the interview results and it will not impact me accounting for your views in my research. If you do choose to draw, you are welcome to stop drawing at any time. I have roughly figured that you will need about 5 minutes per drawing – but if you'd like more time, that's fine. What can I clarify before we get started?"

"Ok, first drawing… Please draw the ideal Grenadian waste management system"
"Second drawing… please draw what the current Grenadian waste management system looks like"
"Final drawing…please draw what could the Grenada waste management system look like"

### Example of Written Instructions

**What is the ideal Grenadian waste management system?**

Interview no._____

**Prompts Key**

1. If participants are drawing without trouble, **no prompts given.**
2. If participant is experiencing trouble after one minute of being given the drawing instructions, **first prompt given:**
    a. "Ok, you could think about….
        i. Institutions
        ii. People
        iii. Places
        iv. Kinds of waste"
3. If participant continues to experience trouble after two minutes of being given the drawing instructions, **second prompt given:**
    a. "Let's imagine an ideal waste management system – what kinds of waste is there? How is it generated? Who generates it?"
4. If participant continues to experience trouble drawing, **third prompt given:**
    a. **"**Here are some examples of things that might be included in your waste management system. You can stick them to your picture if you want using the scissors and glue provided."

**WASTE COMPONENTS:**

## Appendix 16: Semi-structured Interview Protocol for citizens

Interviews will take approximately 45 minutes to complete, following the rich picture method (15 minutes).

| **Topic** | **Grand Tour Questions** | **Probing Questions (only when needed to get more information).** | **Approximate time for each question** |
|---|---|---|---|
| Introduction | Verbal script: Thank-you so much for drawing these pictures [if applicable]. The next part of this interview, I will ask you a series of questions about your picture. But my hope is that this can be a reciprocal process where we both feel like we learn something today. Just to give you a bit of an outline of how I have structured this interview…I am using a 'semi-structured' process, which means that I have outline some key questions that I would like to understand – but aside from that, this is a conversation. So, at any point along the way, please feel free to ask me questions as well. It's my hope that this is very much a conversation. Is there anything that I can clarify about the interview process?<br><br>So, to give you a bit of some background information, this interview process is part of a larger study that is looking at the Grenadian Waste management system. To date, I have interviewed several people in the GSWMA, and I have calculated the types and quantities of materials that are flowing through the waste system – from households and businesses to the landfill. My hope through interviewing you are that I will gain some perspective about waste management in [insert name of Parish]. | | 2 mins |
| Ideal waste management system | Can you describe to me what you drew as the ideal waste management system?<br><br>OR<br><br>Can you describe to me an ideal waste management system? | Who are the key people in this diagram?<br>What are the key locations?<br>What are the biggest waste types?<br>What is the relationship between [actor, stakeholder] and [actor, stakeholder]?<br>Is there any key laws or regulations that influence this system?<br>Are there any cultural "rules" that influence this system?<br>Who is influential in this system?<br>Is there anything missing in this system that you'd like to add now? | 10 minutes |

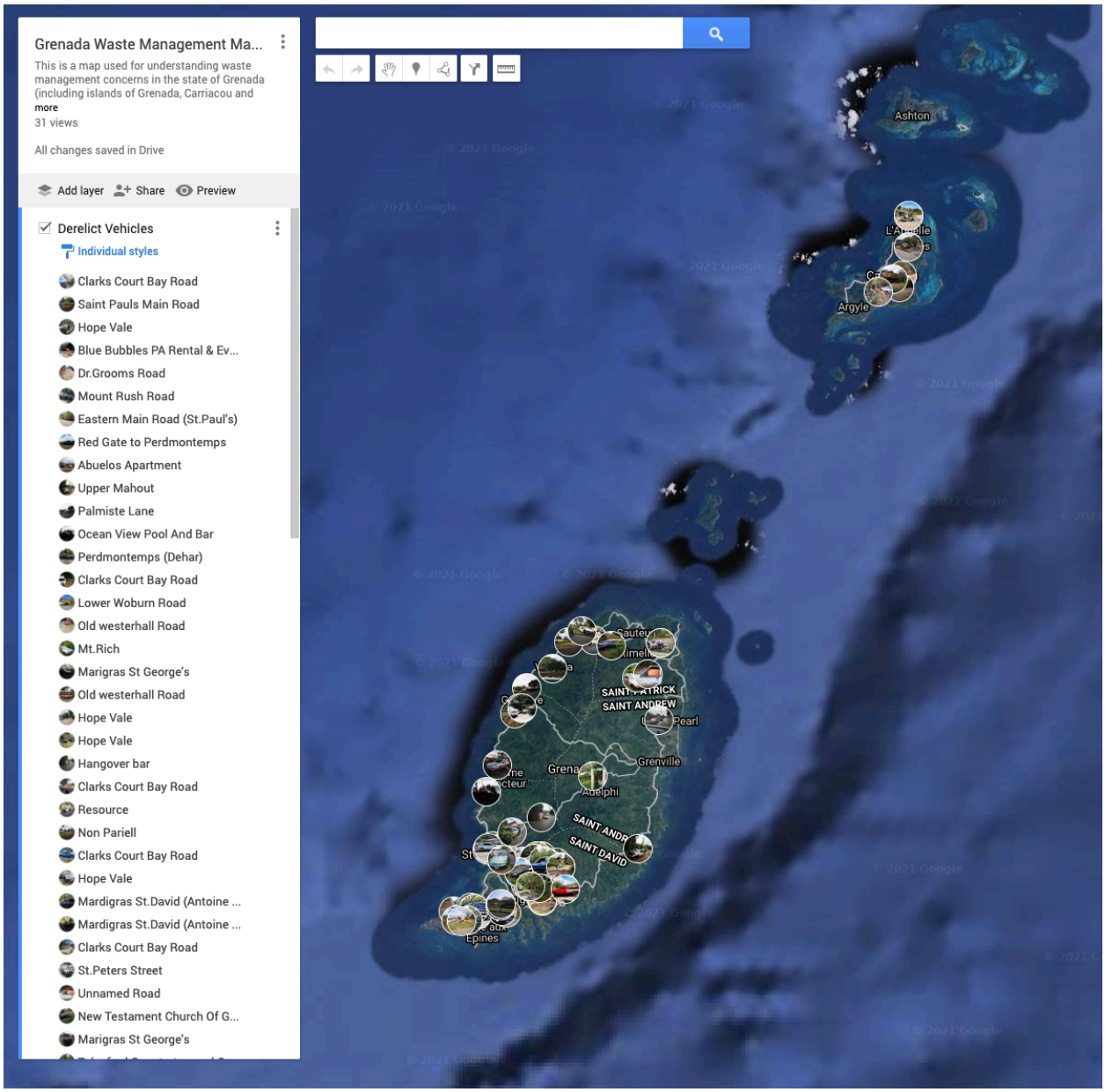
| | | | |
|---|---|---|---|
| | How is waste disposed of in an ideal waste management system? | Is waste ever dumped illegally?<br>Does it all go to the landfill | |
| Current waste management system | Can you describe to me what you drew as the current waste management system?<br><br>OR<br><br>Can you describe to me the current waste management system? | Who are the key people in this diagram?<br>What are the key locations?<br>What are the biggest waste types?<br>What is the relationship between [actor, stakeholder] and [actor, stakeholder]?<br>Is there any key laws or regulations that influence this system?<br>Are there any cultural "rules" that influence this system?<br>Who is influential in this system?<br>Is there anything missing in this system that you'd like to add now? | 10 minutes |
| | How is waste disposed of in the current waste management system? | Is waste ever dumped illegally?<br>Does it all go to the landfill | |
| Possible/future waste management system | Can you describe to me what you drew as the future waste management system?<br><br>OR<br><br>Can you describe to me the future waste management system? | Who are the key people in this diagram?<br>What are the key locations?<br>What are the biggest waste types?<br>What is the relationship between [actor, stakeholder] and [actor, stakeholder]?<br>Is there any key laws or regulations that influence this system?<br>Are there any cultural "rules" that influence this system?<br>Who is influential in this system?<br>Is there anything missing in this system that you'd like to add now? | 10 minutes |
| | How is waste disposed of in the future waste management system? | | |

| | | | |
|---|---|---|---|
| Actions to be taken to change the waste management system | What are the differences between your three diagrams?<br><br>OR<br><br>What are the differences between an ideal, current and future Grenadian waste management system? | What is different between the ideal system and the current system?<br>What are the differences between the current system and the future system?<br>What are the differences between the future system and the ideal system? | 5 minutes |
| | What are some changes that would be necessary to move from the current to the ideal? | What changes would need to be made in actions from the government?<br>What changes would need to be made from the waste management authority?<br>What changes would need to be made by businesses?<br>What changes would need to be made by individuals or households?<br>Are there any sectors or businesses that would be helpful?<br>Are there any policies or regulations that would be helpful?<br>Are there educational opportunities that would be helpful? | 5 minutes |
| | What is promising or exciting about the future of waste management in Grenada? | Is a desirable future waste management system possible? | 5 minutes |

## Appendix 17: Estimates of Litter and Dumping at 1.5% of Waste in Dumpsite

| | **Est_1 (2018 Aggregated by Sector)** | **Est_2 (2018 Disaggregated by Sector)** | **Est_3 (2003)** |
|---|---|---|---|
| Paper | 74 | 59 | 125 |
| Glass | 45 | 40 | 48 |
| Construction materials | 125 | 135 | 117 |
| Metals, electronics, and vehicles | 68 | 77 | 48 |
| Tyres and rubber | 8 | 8 | 8 |
| Plastics | 111 | 90 | 70 |
| Textiles & clothing | 31 | 37 | 24 |
| Hazardous | 45 | * | * |
| Other waste (hazardous, non-recyclable and non-hazardous) | ^ | 75 | 3 |
| Total | 507 | 521 | 444 |

# Appendix 18: Derelict vehicle map



## Appendix 19: Prioritized Listing of Action Plan Initiatives from Grenada's "4 Rs" Final project report and Addendum

Actions listed in the National Waste Management Strategy (Government of Grenada, 2003):

1. Established shipping fees and material controls at landfills
2. Participate in regional waste Management Association
3. Monitor local market conditions recyclables
4. Reduce the frequency of residential waste collection
5. Establish a public communications and education program
6. Provide adequate resource is to support enforcement
7. Establish an "half back" deposit/refund system
8. Promote residential backyard composting
9. Prepare "best practices" waste diversion guides
10. Established a regional diversion support program
11. Require definition of planning waste management provisions
12. Establish a windrow composting operation at the landfill
13. Identify a partner to initiate composting
14. Establish C&D diversion practices at the landfill facility
15. Establish landfill processing operations for glass and tyres
16. Participate in multi-island salvageable metals program
17. Facilitate development of multi-island salvageable metals program
18. Prepare an incorporate waste diversion materials/curricula.
19. Establish a funding program supporting diversion initiatives
20. Promote the use of food waste as animal feed
21. Develop a government policy supporting waste diversion
22. Promote residential SWAP Events/Yard Sales.
23. Undertake waste characterization studies
24. Establish diversion equipment reserve fund
25. Promote ICI generator waste audits
26. Established legislation defining management facility permitting
27. Develop public sector green programming initiatives

28. Establish a MRF[54] at the landfills facility
29. Develop industry stewardship agreements for select materials

[54] Material recovery facility

## Appendix 20: List of actions items for the 5-year implementation of the National Waste Management Plan

| Implementation Program Component | Action Item No. | Action Item | Establishment/ Implementation Costs (EC$) | Annual Operation/ Maintenance Costs (EC$) |
|---|---|---|---|---|
| Institutional Arrangements, Policy and Regulation Development | 1 | Review Position Descriptions for GSWMA Personnel | $6,000 | |
| | 2 | Collect Additional Waste Characterization Data | $240,000 | $35,800 |
| | 3 | Identify an Individual to Manage the Ministry of Health and Environment's Obligations Under the Waste Management Act | $61,000 | $70,000 |
| | 4 | Establish a National Waste Management Forum | $3,000 | $8,000 |
| | 5 | Prepare and Implement Waste Management Operations Plan | $38,000 | |
| | 6 | Prepare Waste Management Regulations | $84,000 | |
| Management, Operations, Monitoring, and Enforcement | 7 | Support Further Development and Implementation of National Special Waste Management Programs | $12,000 | TBD |
| | 8 | Establish a Tipping Fee and Incoming Material Controls at Perseverance and Carriacou Landfills | $20,000 | |
| | 9 | Implement a Litter Control Program | $43,000 | |
| | 10 | Implement Actions to Enhance Enforcement of | $30,000 | $12,000 |

| | | | | |
|---|---|---|---|---|
| | | the Waste Management Act | | |
| | 11 | Establish A Duty Relief Program for Import of Waste Diversion an Approved Collection Equipment | $5,000 | $3000 |
| | 12 | Establish A Waste Management Training Program | $38,000 | $72,000 |
| | 13 | Establish a Regional Technical Assistance Program | $20,000 | $78,000 |
| | 14 | Establish Landfill Processing/Diversion Operations for Green Waste, C&D Materials, Tyres and Glass | $58,000 | $345,000 |
| | 15 | Establish a "Half-Back" Deposit/Refund System for Select Materials | $126,000 | $23,000 |
| | 16 | Establish a Multi Island Salvageable Metals Collection and Processing Program | $22,000 | $105,000 |
| Public Education & Awareness | 17 | Implement a National Waste Management Public Awareness Program | $134,000 | $125,000 |
| | 18 | Implement Product Stewardship Agreements | $61,000 | $7,000 |
| | | **Total** | **$1,001,000** | **$883,800** |

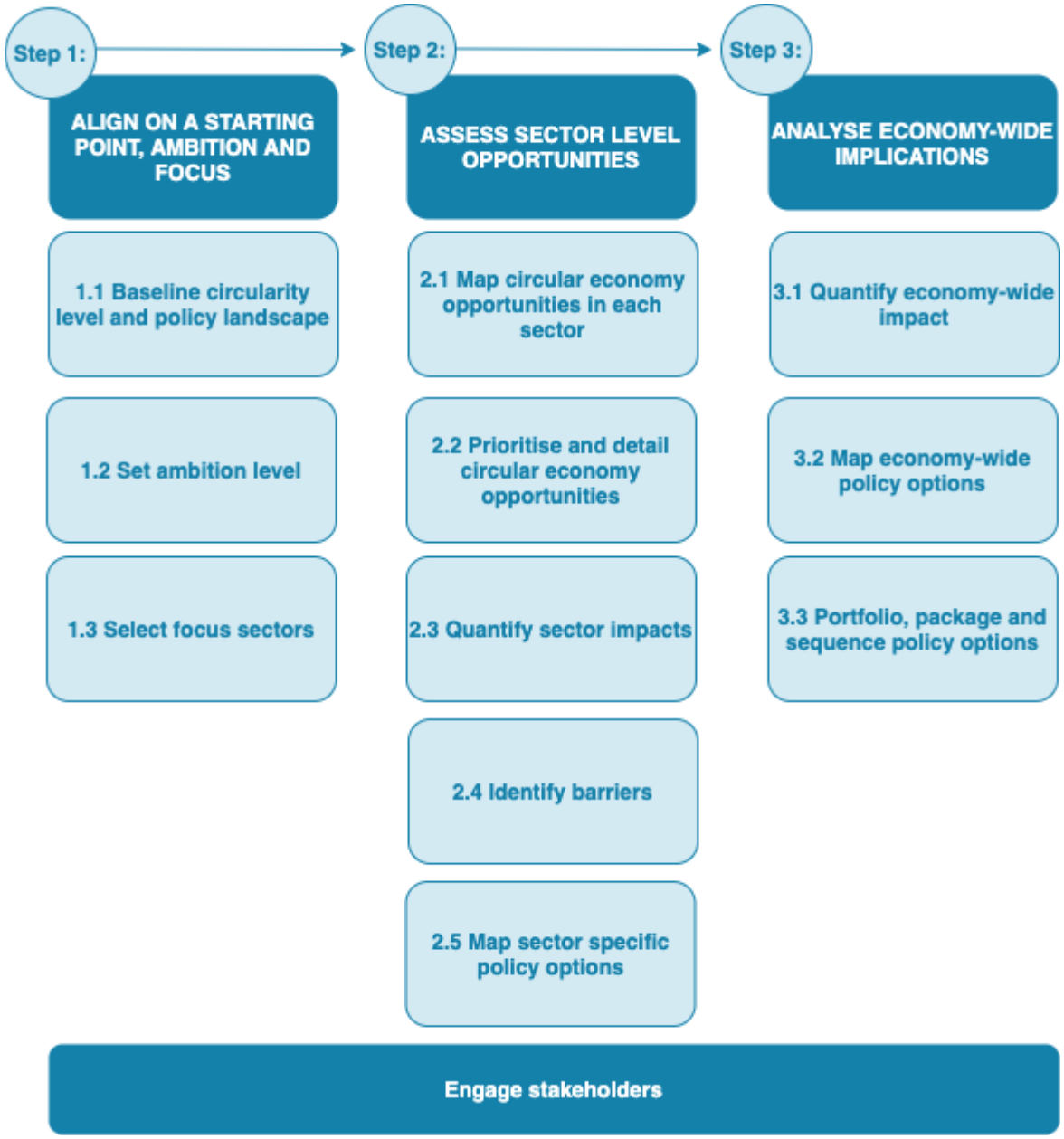
Source: Published in the National Waste Management Strategy for Grenada (Government of Grenada, 2003)

## Appendix 21: Barbados Programme of Action Section III Management of Waste – National action, policies, and measures

| National action, policies, and measures: | Status or action to date |
|---|---|
| (i) Develop fiscal and policy incentives and other measures to encourage environmentally sustainable imports and local products with low waste or degradable waste content. | Specific measures addressing select products: In 2020, Grenada banned importation of vehicles over 10-years old. In 2018, Grenada enacted the Non-Biodegradable Waste Control Act – Styrofoam food containers and handled shopping bags banned to date. |
| (ii) Develop and implement appropriate regulatory measures, including emission discharge and pollution standards, for the reduction, prevention, control and monitoring of pollution from all sources; for the safe and efficient management of toxic, hazardous and solid wastes, including sewage, herbicides, pesticides and industrial and hospital effluent; and for the proper management of disposal sites | No regulatory measures in place. |
| (iii) Ratify and implement relevant conventions, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention of 1972), as well as relevant regional conventions. | Cartagena Convention ratified, but other conventions including Basel and MARPOL are not or only partially ratified. |
| (iv) Formulate and implement public awareness and education campaigns designed to gain local recognition of the need to control wastes at the source; of the value of reuse, recycling and appropriate packaging; and of the possibilities for converting wastes to resources in culturally appropriate ways | GSWMA PR department engages in education activities including the Environmentally Friendly Schools program and other contests. |
| (v) Introduce clean technologies and treatment of waste at the source and appropriate technology for solid waste treatment. | Implementation of sanitary landfills failed to date; most measures 'end-of-pipe' and are not 'clean' or treat waste |
| (vi) Develop information systems and baseline data for waste management and pollution control, monitoring the types and quantities of wastes, for both sea- and land-based sources of pollution. | Minimal measures in place. Data for waste generation is collected with some limitations and reliability issues, but not publicized. |

| | |
|---|---|
| | Baseline for waste quantities by material type are not available.<br>No monitoring of pollution, including air pollution from burning and water pollution from dumpsite leaking |
| (vii) Establish port reception facilities for the collection of waste in accordance with annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). 7/ | Grenada is not a signatory for MARPOL 73/78 Annex V |
| (viii) In conformity with the Basel Convention and relevant decisions taken by the parties to that Convention, formulate and enforce national laws and/or regulations that ban the importation from States that are members of the Organisation for Economic Cooperation and Development (OECD) of hazardous wastes and other wastes subject to the Basel Convention, including hazardous wastes and other wastes destined for recycling and recovery operations. | Grenada has not ratified the Basel Convention<br>No laws banning importation of hazardous waste. |

## Appendix 22: Step-by-step methodology for implementing a circular economy



## Appendix 23: Universal Circular Economy Policy Goals

| Policy Goal | Description of the policy goal | Examples of types of policies and legislation that could be applied in Grenada, based on (EMF). |
|---|---|---|
| Goal #1: Stimulate design for the circular economy | Enable all products to be designed, accessed, and used in ways that eliminate pollution and waste, circulate materials and products on markets effectively. | • Product policies that focus on high quality, designed for durability, reusability, repairability, remanufacturing, recyclability, and compost-ability.<br><br>→ In 2020, Grenada banned importation of vehicles over 10-years old.<br><br>• Ban use of harmful substances that cannot be managed safely, or are incompatible with current waste management technologies<br><br>→ In 2018, Grenada enacted the Non-Biodegradable Waste Control Act |
| Goal #2 Manage resources to preserve value | Keep materials and products at their highest possible value through business models and resource management systems. | • Stimulate sharing, repair, and remanufacturer through tax incentives<br>• Extended Producer Responsibility and Deposit-Return Schemes<br>• Amendment of the Environmental Levy Act to include a broader deposit return system<br>• Require food manufacturer companies to take responsibility for the waste generated<br>• Sorting policies to facilitate resource circularity<br>• Align export and import flows with resource management capabilities<br>• Aside from the Non-Biodegradable Waste Control Act and import ban on vehicles, no limitations on imports in Grenada. Opportunity to limit importation of materials that cannot be reasonably managed<br>• Disincentivizing landfilling and incineration<br>• Grenada is currently prioritizing landfilling in current waste management. |
| Goal #3 Make the economics work | Make circular economy outcomes the norm by creating economy incentives and setting regulatory requirements. | • Align taxation with circular economy outcomes (e.g., switching taxes from labour to non-renewable resources)<br>• Incorporate circular economy in trade policies |

| | | |
|---|---|---|
| Goal #4 Invest in innovation, infrastructure, and skills | Stimulate private investment and invest public money in developing skills, innovation, and infrastructure for circular economy | • Adapting the curriculum to include the circular economy in schools<br>• Research funding for circular economy solutions<br>• Expand environmental levy to fund innovative solutions and infrastructure across scales |
| Goal #5 Collaborate for system change | Work across government departments at all scales to align policy, embedding circular economy in all sectors. Foster responsive public-private collaborations across value chains. | • Build international policy alignment with global agreements<br>• Developing circular economy roadmaps |