Marine Pollution in the Caribbean:

Not a Minute to Waste

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Organisation of Eastern Caribbean States

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Acronyms and Abbreviations

ACS	Association of Caribbean States
ALDFG	Abandoned, Lost, or Otherwise Discarded Fishing Gear
ARD	Acute Respiratory Distress
CARICOM	Caribbean Community
CARIFORUM	Caribbean Forum of ACP States
CARPHA	Caribbean Public Health Agency
CCCCC	Caribbean Community Climate Change Centre
CDEM	Construction, Design, Equipment, and Manning
CDEMA	Caribbean Disaster Emergency Management Agency
CLME	Caribbean Large Marine Ecosystem and Adjacent Regions
CLME+	Caribbean and North Brazil Shelf Large Marine Ecosystems
CReW	Caribbean Regional Fund for Wastewater Management
CRFM	Caribbean Regional Fisheries Mechanism
CSC	Caribbean Sea Commission
EEZ	Exclusive Economic Zone
EPA	Environmental Protection Agency
EU	European Union
GCFI	Gulf and Caribbean Fisheries Institute
GDP	Gross Domestic Product
GPA	Global Programme of Action
GPML	Global Partnership on Marine Litter
ICZM	Integrated Coastal Zone Management
IDB	Inter-American Development Bank
IMO	International Maritime Organization
IWEco	Integrating Water, Land, and Ecosystems Management in Caribbean Small Island Developing States
LAC	Latin America and the Caribbean
LBS	Land-Based Sources
LME	Large Marine Ecosystem
LMR	Living Marine Resource
OECD	Organisation for Economic Co-operation and Development
OECS	Organisation of Eastern Caribbean States
RAPMaLi	Regional Action Plan on Marine Litter
SAP	Strategic Action Programme
SCP	Sustainable Consumption and Production
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
SPAW	Specially Protected Areas and Wildlife
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNEP-CEP	United Nations Environment Programme—Caribbean Environment Programme
USA	United States of America
WCR	Wider Caribbean Region
ZVD	Zika Virus Disease

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Overview

The words "the Caribbean" inevitably evoke in people's minds white sandy beaches, blue seas, and bright sunshine. The region is one of the most frequented tourist hotspots in the world, each year attracting more than 27 million visitors who are eager to play and spend on its shores. The rich flora and fauna found below the crystal-clear surface of the Caribbean's blue waters are what makes this all possible. They help to sustain the scenery, are infused into the culture, and drive economic development within the countries of the region.

Around the world, the enormous value of oceans is slowly being recognized. Oceans and their processes are responsible for the planet's rainwater, weather, climate, coastlines, oxygen, and food resources on land and sea. They have been the platform for trade, transportation, human culture, and history. The great expanses of salt water, therefore, are critical for humankind and its well-being, and not least through their role driving the world's economies. Recent estimates place the oceans' direct annual contribution to global GDP at between US$1.5 and $3 trillion—and this figure does not include indirect contributions from functions such as coastal protection, carbon sequestration, and biodiversity.

In the wider Caribbean Region (WCR)[1], especially in the Small Island Developing States (SIDS)[2], marine ecosystems provide food, livelihoods, and income to over a hundred million people through fisheries, tourism, coastal protection, and transportation. In 2017, the insular Caribbean's gross revenues from marine and coastal tourism alone totaled an estimated US$57 billion. The ocean brings in billions of dollars more through fisheries and ocean-going transportation.

This lucrative resource, however, is threatened by changes in an underwater environment that for too many of us remains "out of sight, out of mind." In the last 50 years, rises in ocean temperatures, overexploitation of fisheries, damage to habitats by out-of-control coastal development and unprecedented pollution have caused a dramatic decline in the Caribbean's natural environment. Pollution generated inland, particularly in SIDS or small coastal countries, also impact the marine environment through run-off and improper solid waste management, further affecting critical ecosystems.

Without improved management of the Caribbean's natural capital, the region stands to lose its economic backbone—a vibrant, healthy ocean that provides food and income to its population year after year. Declines in the fisheries and tourism sectors, for example, may have deleterious effects on Caribbean economies, where tourism accounts for 15 percent of the region's GDP (WTTC 2018) and fisheries within the Caribbean Regional Fisheries Mechanism region employ over 340,000 people (4.3 percent of the workforce in the region).

The inevitable question is, how can we safeguard the economies and livelihoods of the region's population while protecting the natural capital and restoring the damaged ecosystems? This report aims to provide answers to this and other critical questions.

1 For the purposes of this report, the WCR is the region encompassing all the coastal states and territories bordering the Caribbean Sea, plus the Bahamas. Information and data from the Gulf of Mexico and the United States are limited to region-wide assessments and are specifically referenced in the report. See Chapter 2 for a complete list of countries.

2 The WBG defines Small Island Developing States as countries that: (a) have a population of 1.5 million or less, or (b) are members of the Small States Forum. Caribbean small states include Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

Foreword

Let's start with the wins. There are currently 14 Caribbean countries, from Aruba to Haiti to the U.S. Virgin Islands that have banned plastic bags and/or Styrofoam as part of their efforts to tackle marine pollution. Other countries in the Caribbean and Latin America are following suit and banning single-use plastics as well as adopting a combination of policy and infrastructure measures to deal with this issue in an integrated manner. As the Caribbean is moving toward a blue economy - with the aim of increasing growth while ensuring that ocean and marine resources are sustainably managed and used - marine pollution needs to be urgently addressed. Marine pollution poses a direct and immediate threat to the USD $57 billion of revenue that the region's coastal tourism brings in annually. The World Bank report, *"Marine Pollution in the Caribbean: Not a Minute to Waste,"* identifies the key sources of marine pollution in the region and highlights the major socio-economic, health, and ecological impacts of these pollutants.

The Caribbean Sea is the lifeline of these Caribbean nations, supporting 37 distinct economies that are the most tourism dependent in the world. Tourists flock to the region for the beauty, biodiversity and rich marine ecosystems that are now imperiled. Coral reefs, beaches, and mangroves are critical for the sustainability of many economic activities, jobs and inclusive growth. Yet the data is unmistakable: the sea and marine ecosystems are being degraded by wastewater, urban and solid waste, agricultural runoff, and hazardous pollutants from oil and mining. Coral reef degradation is probably the single most serious threat to the natural capital of the Caribbean, with an estimated annual revenue loss of between $350 million and $870 million. Caribbean Small Island Developing States (SIDS) are particularly exposed and vulnerable to increased damage from marine pollution, and the cost of inaction will be significant reduction in revenues from the tourism and fishing industries that these countries depend on.

This report proposes a 12-point action agenda for responding to this pollution threat. These recommendations are aligned with regional and international mandates and, if adopted, can significantly contribute to the Caribbean's transition toward a blue economy. Marine pollution prevention and control should be considered a top priority for all SIDS in the Caribbean and aligned with broader planning in tourism, agriculture, coastal development, among other sectors. Addressing this issue, requires collaborative approaches in areas such as legislation, policies and enforcement; infrastructure investments; capacity building; monitoring programs; education and public awareness, among others – tackled both at the national and regional levels. Reducing marine pollution will lead to economic growth, improved quality of life and health for island residents, significant conservation of natural capital, and continued exploring for the tourists they host. The time is now to tackle marine pollution as an imminent threat to our ocean and to our SIDS countries. The solutions are in our hands. We must take responsibility to create a prosperous blue legacy for future generations.

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The finding, interpretations, and conclusions expressed in this document are those of the authors and do not necessarily reflect the view of the Executive Director of the World Bank, the governments they represent, or the counterparts consulted during the study process. Any factual errors are the responsibility of the team.

Executive Summary

Objective of the Report

The economic prosperity and sustainable development of the Wider Caribbean Region (WCR), and in particular Small Island Developing States (SIDS), greatly depend on the wealth of resources provided by the oceans. The marine ecosystems of the Caribbean provide food, livelihoods, and income to millions of people through fisheries, tourism, coastal protection, transportation, and resilience to climate change. In 2017, gross revenues from marine and coastal tourism alone were estimated to total US$57 billion. Building a sustainable ocean economy — the Blue Economy — through better and more effective use of marine resources holds enormous potential for income growth, community development, environmental protection, and poverty reduction.

Marine pollution is now ubiquitous in Caribbean waters, and a serious threat to the Blue Economy. Pollution, including marine litter, plastics, sewage, oil and chemicals, impacts the value of the goods and services provided by the oceans, including quality of fisheries and the pristine marine environment highly valued by the tourism sector. The region is extremely vulnerable to the impacts of marine pollution due to the dependence of its people on natural resources in combination with its vast exposed coastlines. Understanding and addressing marine pollution in the region is an economic and social priority in addition to the environmental threat. Countries now recognize the potential of the ocean and are weighing policy shifts to protect their valuable coastal and marine natural capital to reap the full benefits of the Blue Economy.

This report provides an assessment of the status and impacts of marine pollution in the Caribbean and provides recommendations to enhance the region's resilience as it steers toward the Blue Economy. The report compiles data and findings on marine pollution from a variety of sources and publications to provide meaningful guidance to policy and decision makers in the WCR, especially Caribbean SIDS and donor partners supporting the post-2015 Sustainable Development Agenda. It highlights the major socio-economic, health, and ecological impacts of marine pollution, and provides an assessment of the main marine pollutants in the region including marine and coastal litter, untreated wastewater, and agricultural run-off. Industrial pollution and waste from shipping are not widely documented in the region but potentially important, and thus are included in the report. The main regional policy frameworks, initiatives and programs relevant to marine pollution management are also described, followed by a 12-point agenda for addressing the challenges in support of a strong and productive Caribbean Blue Economy.

Marine Pollution Assessment in the Caribbean

Solid waste and wastewater are the most pervasive sources of marine pollution in the region. These sources are projected to increase as populations, coastal cities, and tourism continue to grow. Eighty percent of marine pollution results from direct or indirect discharge of solids and liquids from land-based sources such as rivers, outfalls, waterways, agricultural runoff, and infrastructure. The rest enters the oceans through petroleum exploration and production, shipping, discarded fishing gear, and the atmosphere. Cities along the coast are particularly problematic sources of untreated wastewater and litter due to inadequate waste collection, disposal, and treatment facilities. Improving waste management systems remains a major challenge in the Caribbean region.

Wastewater poses a significant threat to the region's development and the quality of life of its people. On average, about 85 percent of wastewater in the WCR goes untreated into the ocean. In the insular Caribbean, about 52 percent of households lack sewer connections and only 17 percent have acceptable collection and treatment systems. Small islands often have insufficient or no waste water treatment facilities at all. Domestic wastewater

treatment rates are low for the entire region—on average, only 37 percent of the wastewater which flows into WCR waters from larger countries (excluding the United States) is treated. For island nations, these percentages are even lower, only 8 percent (mostly with primary treatment). While some countries have succeeded in increasing the number of private wastewater treatments plants, supervision by state agencies is often poor and many of the plants are dysfunctional. The high concentration of nutrients, primarily from inadequately treated sewage, has far-reaching impacts beyond coral reefs and could pose the largest single threat to the US$57 billion of revenue that the region's coastal tourism brings in annually. Contamination of the coastal marine environment by sewage can lead to the transmission of infectious diseases (diarrhea, cholera, typhoid, and hepatitis A) to people swimming in marine waters or eating seafood.

Marine litter is accumulating in the Caribbean Sea, originating both in the region as well as distant countries overseas through the ocean currents. Studies have measured the concentration of plastic litter across the Caribbean and found as many as 200,000 pieces of plastic per square kilometer in the northeastern Caribbean. Marine litter in this hotspot has been found to originate from the Caribbean as well as from northern waters. These plastics settle throughout the water column, fragmenting into smaller pieces called microplastics, now considered an emerging marine pollutant. As marine litter accumulates in the ocean, SIDS are often exposed to concentrations of litter that are disproportionate to their own consumption and population. A snapshot of the level of litter in coastal areas, for selected countries featured in this report, shows that an average of 2,014 litter items per kilometer were found on beaches and coastal areas as compared to a global average of 573. The most common marine litter found was plastic bottles, in addition to other single-use plastic items, and foam containers. Abandoned, lost, or otherwise discarded fishing gear (ALDFG) is another critical type of marine debris and is considered the main source of plastic waste in the marine environment coming from the fisheries and aquaculture sector.

Plastic has been found to be a key component of marine litter in the Caribbean. While plastic represents only 12 percent of the solid waste that is generated in the Caribbean, it is a crucial component of marine and coastal litter. Plastic is resistant to degradation relative to other forms of solid waste, remaining in the environment for years. Up to 80 percent of the litter found in our oceans is made of plastic. Caribbean data from beach and coastal clean-ups in 2017 indicate that plastic beverage bottles alone amount to 21 percent of the items recorded. When other common plastic items are counted, 35 percent of all items are single-use plastic. Poor household collection service is among the significant reasons why plastics enter the marine environment. An estimated 322,745 tons of plastic go uncollected each year across selected Caribbean countries. Of these, 22 percent of the households dispose of waste in waterways or on land where it can be washed into the waterways. As part of the efforts to reduce marine litter, Caribbean countries have joined the global movement to adopt education campaigns, public awareness, and introduction of new legislation to reduce persistent marine litter items. A total of 14 Caribbean SIDS has banned the use of litter such as single-use plastic bags and Styrofoam. Countries that manage and plan for prevention and abatement of waste will benefit from a cleaner environment which can in turn improve international investment, tourism, and economic growth.

Run-off from agricultural non-point sources, including fertilizers and pesticides, is a significant concern in the region. Countries in the WCR with large agriculture practices use significantly higher levels of fertilizer per hectare of cultivated land than most countries, and much of this ends up in the Caribbean Sea rivers and watersheds. Most rivers in the WCR discharge significant sediment loads, straining biodiversity and shallow coastal waters. Sediment loads from the Meso-American region (Belize, Guatemala, Honduras, and part of Mexico's Yucatan Peninsula) contribute significant amounts of sediment to the WCR—374 million tons per year. Land-based activities including agriculture, forestry, urbanization, and mining contribute further to sedimentation and erosion.

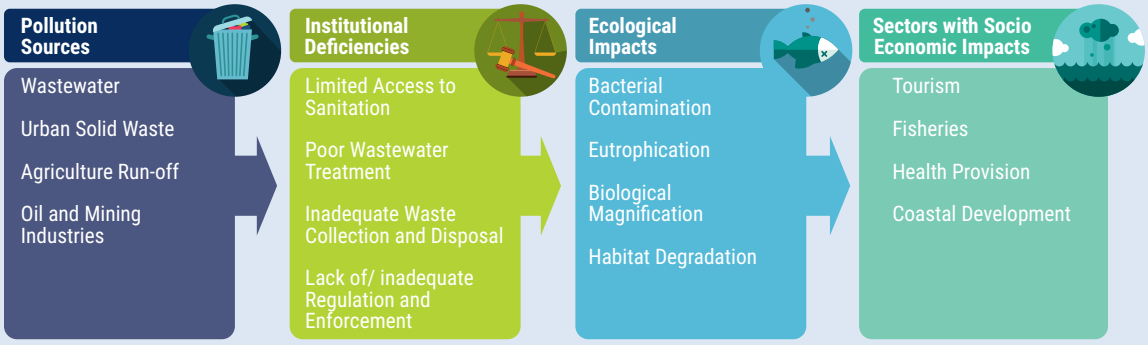
Oil spills due to shipping are also contributing to marine pollution in the region. Shipping is a major segment of the ocean economy in the WCR, but it comes with a high environmental cost. In 2012, 8.2 percent of global container shipping volume passed through the region due to the presence of the Panama Canal. With an average of five million barrels of crude oil moving daily through the WCR and 70 million tons passing annually through the Panama Canal, estimates show that about 250 major and minor oil spills will occur each year in the Caribbean Sea and the Gulf of Mexico. A study concluded that approximately 83 percent of the Caribbean Sea was at risk from

oil spills due to shipping. The WCR is one of the world's busiest destinations for the cruise ship industry, with a 34 percent share of the global market in 2013. On a one-week voyage, a middle-sized cruise ship (about 3,500 passengers) generates 795,000 liters of sewage, 3.8 million liters of grey water, 500 liters of hazardous waste, 95,000 liters of oily bilge water, and eight tons of garbage. Unfortunately, most of the region's small ports have limited infrastructure facilities for handling waste and sewage from these guests. Countries that do not maintain clear and clean waterways suffer from loss of business.

Industrial activities in the WCR such as oil refining, food processing, chemical manufacturing, and mining are potential threats both to marine resources and human health. Ninety percent of hydrocarbon pollution in the region's marine environment originates from land-based industrial sources and activities, including oil refineries, which number over 100, with 75 percent of them located along the Gulf of Mexico. While many Caribbean countries have no major industries, industrial hotspots around the Gulf of Mexico discharging substantial pollutant loads into the marine environment find their way to the waters of other countries. The smallest industrial pollutant loads come from the western Caribbean (the Central American countries), while in the eastern Caribbean, Trinidad and Tobago contribute the largest industrial pollutant loads to the marine environment, due to the increased industrial development, notably oil facilities.

The impacts of marine pollution go far beyond harming the natural environment, undermining economic growth and livelihoods while adversely affecting human health. Since marine pollution and the associated ecological and socioeconomic impacts are a result of human activity, there is increasing cognizance that the cost of inaction will increase significantly. These costs will be further amplified by the added externality of climate change, and the extreme weather events. Tourism, fisheries, health and coastal development are sectors directly impacted by the various sources of marine pollution. It harms natural aesthetics, marine life, contributes to the risk of mosquito-borne illnesses, and exacerbates flooding in coastal areas. The costs of inaction will likely be greater than those associated with pollution prevention and management, given the economic impact on these sectors.

Linking Pollution with Drivers and Impacts in the WCR

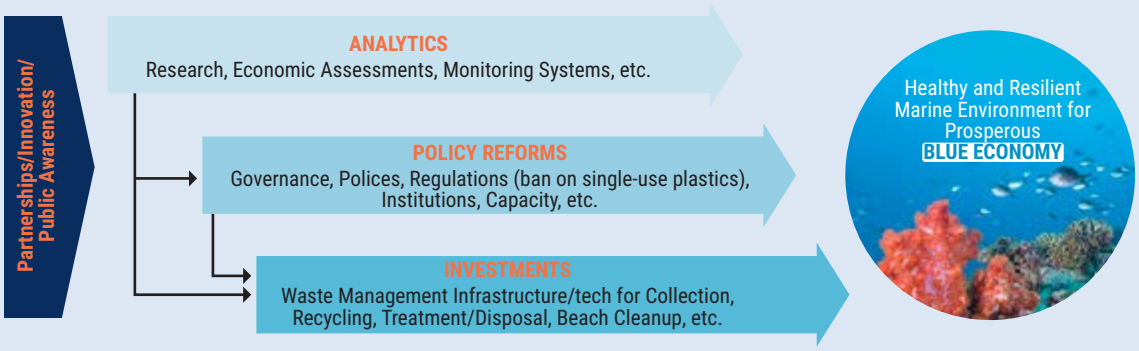


The global and regional policy frameworks addressing marine pollution are comprehensive and cover the major sources of marine pollution. These frameworks offer a blueprint for an integrated, multi-sectoral response to marine pollution. Though the region's governments have made commendable progress since the mid-1970s in enacting environmental policies, the wholescale degradation of waters has increased with population and development. Given the magnitude of the problem and the political, financial, and institutional costs, actions within countries are often fragmented and short-lived, failing to bring results with the urgency and intensity required.

To heighten effectiveness, national policies on marine pollution should be guided by, and aligned with, regional and global frameworks. This would help countries to meet international commitments (e.g. SDGs) and fully benefit from international cooperation, resources, and funding from donors and partners. There is tremendous potential for governments to build on programs already in place. What is now required is a shift in thinking and the political will to focus on critical policy entry points. The well-being of the growing population of the region requires that these issues and trends be addressed urgently. There is no time to waste!

Recommendations

This report presents a 12-point action agenda for combating marine pollution in the region, targeting Caribbean SIDS. These nations are particularly exposed and vulnerable to the present and future damage from marine pollution, which leads to reduced revenues from the tourism and fishing industries that these countries depend on. The World Bank proposes an actionable agenda for responding to pollution problems facing Caribbean SIDS that takes forward-looking and concrete steps in support of a healthy, productive, and resilient Caribbean Sea. A proposed way forward incorporates preventative and responsive approaches through a combination of analytical activities, policy reforms for enhancing the enabling environment, strategic investments, public awareness, partnerships and innovation. The framework for action involves four broad groups of activities that are needed to effectively find solutions for marine pollution. The scale of these activities ranges from the local to national to regional. These are aligned with relevant international and regional mandates, and if adopted would significantly contribute to the region's pathway toward the Blue Economy.



1. Improve the knowledge base on marine pollution and water quality throughout the region using common monitoring approaches and guidelines.
2. Step up assessment of the economic impacts of marine pollution, and quantify the costs associated with pollution prevention and management, as well as the costs associated with doing nothing.
3. Strengthen and harmonize existing national institutional structures, policies, and legislation to effectively reinforce regional governance and align with international mandates and commitments.
4. Integrate marine pollution prevention and control policies into the broader context of national policy and planning frameworks.
5. Heighten local expertise and technical capacity concerning pollution and water quality management.
6. Raise public awareness about the importance of water quality and marine ecosystems to induce behavioural change.
7. Strengthen multi-sectoral mechanisms and establish partnerships to address marine pollution.
8. Prioritize, dedicate, and increase funding within national budgets for marine pollution prevention and control.
9. Make a strategic investment commitment to litter control.
10. Make a decisive commitment to reduce consumption of common and persistent litter items including plastics.
11. Implement integrated, high-priority interventions to reduce discharge of untreated sewage and nutrients, and promote resource recovery of waste water.
12. Improve chemical and industrial pollution control through targeted and cost-effective measures in priority issues.

CHAPTER 1

Introduction

Renata Romeo/ coralreefimagebank

Making the case for keeping our oceans healthy should not be necessary. After all, our planet is 70 percent ocean. Oceans contain 97 percent of *all* water on Earth. Their temperature, chemistry, currents, and living resources make life possible for human beings. Oceans regulate the world's climate, and climate regulates life. Rainwater, drinking water, weather, much of the planet's food, and even the oxygen we breathe are all provided or regulated by oceans. Thus, all of the planet's 7.5 billion people depend on oceans in fundamental ways. The three billion who live in coastal communities have an even closer link, depending directly on the oceans for their livelihoods and diets. Globally, the market value of marine and coastal resources and industries is conservatively estimated at US$3 trillion per year, or about 5 percent of global Gross Domestic Product (GDP), (OECD 2016).

The ocean sustains the economy of the Wider Caribbean Region and especially Caribbean SIDS, providing food and livelihoods to its people, and is intricately weaved into its history and social and cultural landscape. Understanding and addressing marine pollution issues in the region is therefore not only an environmental concern but an economic and social priority. The unprecedented and intensified climatic events that have battered the region over the last 20 years make the job all the more urgent.

Since the early 1970s, governments of the region have recognized the environmental and socio-economic linkages and begun considering the sustainability of ocean resources in order to achieve long-term economic prosperity. These efforts have evolved into international environmental and maritime policies and efforts under the framework of sustainable development. However, national action to address environmental issues, in particular marine pollution, has been for the most part limited and fragmented, insufficient to keep pace with development patterns that are driving the environmental degradation. Therefore, if left uncontrolled, marine pollution will continue as a serious threat to the region's pathway toward the Blue Economy.

1.1 Marine Pollution and the Blue Economy: A Primer

A growing number of Caribbean countries are moving toward national development strategies that are strongly underpinned by ocean resources. These countries believe that a more sustainable blue growth-based strategy could help the broader policy objectives of the Sustainable Development Goals, including poverty reduction, food security, energy security, disaster risk reduction, climate change mitigation, and ocean conservation. Pollution of the marine environment, however, poses a significant risk to the economic benefits to be generated by the region's ocean economy.

Box 1.1.1 The Blue Economy Defined

"Sustainable and integrated development of economic activities in healthy oceans".

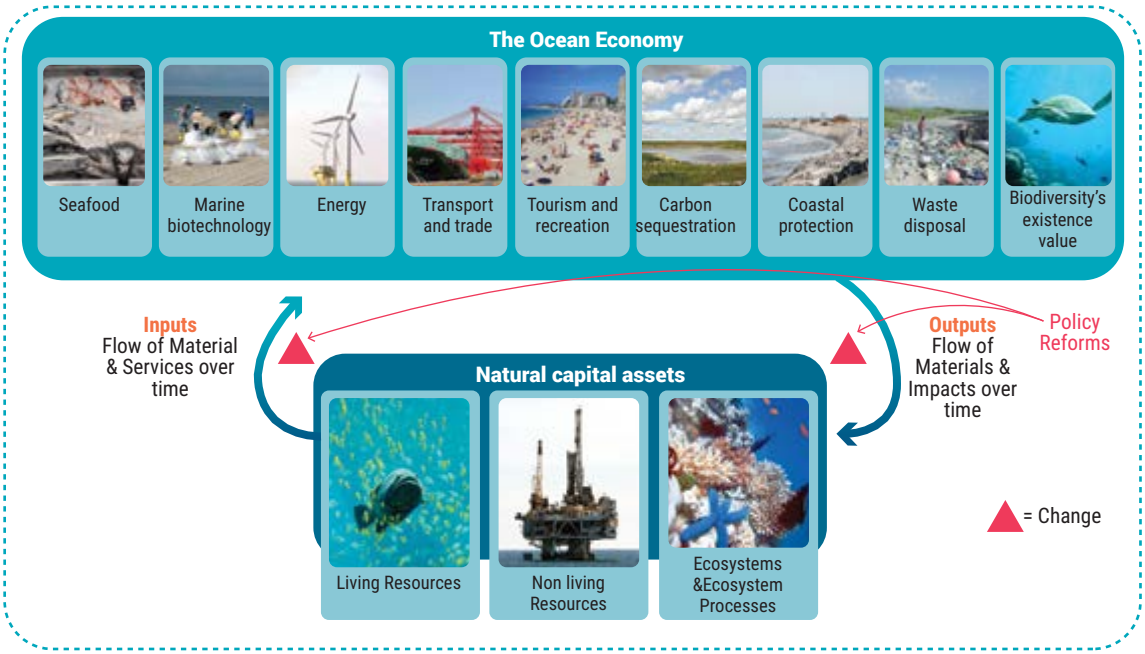
The Blue Economy concept provides social and economic benefits for current and future generations, and restore, protect, and maintain the diversity, productivity, resilience, core functions, and intrinsic value of marine ecosystems.

World Bank, Blue Economy Action Plan (in draft)

The Blue Economy concept considers the ecological systems that provide so many of the services linked to the ocean economy as underlying and sometimes invisible natural capital assets. Natural capital includes living resources (renewable stocks) harvested for use, such as fish; non-living resources (non-renewable stocks) harvested for use, such as seabed minerals; and ecosystems and ecosystem processes by which the living and non-living environments interact as a functional unit (such as coral reef ecosystems and mangrove ecosystems). Many of these natural capital assets are renewable and, if properly managed, can yield benefits sustainably over time. As such, the ocean economy and ecological systems should be considered as one unit in policy design.

Oceans provide three main types of services. First is economic activities such as fisheries, shipping, communications, tourism, and recreation. Second is tangible ecosystem services vital to human life, such as the 50 percent of atmospheric oxygen that microscopic marine plants produce, the natural carbon sinks in mangroves and seagrasses, and the coastal protection from storm surges and waves that coral reefs and mangroves provide to human communities. Third is intangible ecosystem services related to human perception that have aesthetic, cultural, or religious value. All of these marine ecosystem services have substantial economic value estimated in the trillions of US dollars an-

Figure 1.1.1 A Blue Economy Framework



Source: Patil et al. 2016.

nually, with three-quarters of this provided by coastal ecosystems (Costanza et al. 1997 and UN 2016).

A conceptual framework for the Blue Economy in the WCR shows the complex relationship between marine natural assets and economic activity in the region. Figure 1.1.1 illustrates the entry points for policy reforms in order to change the flow of inputs from natural assets to the ocean economy over time, or to reduce its negative outputs, such as pollution.

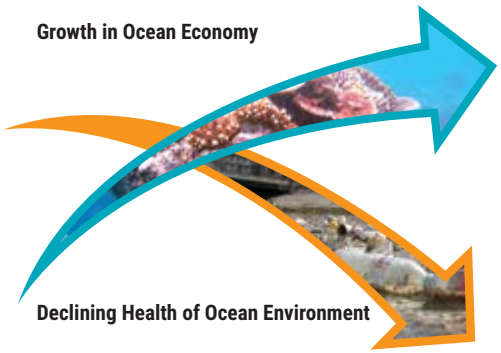
With the expected growth of the ocean economy in the coming decades, the potential harm to its natural capital asset base is significant—and the baseline is already low. In 2016, the United Nations Secretary-General Ban Ki-moon wrote that the findings of the first world ocean assessment "indicate that the oceans' carrying capacity is near or at its limit," and that "urgent action on a global scale is needed to protect the world's oceans from the many pressures they face" (UN 2016). In this context, two parallel trends currently occur globally and within the WCR with regard to the use of ocean resources (Figure 1.1.2). On the one hand is growing ocean-based economic activity (such as shipping, fisheries, and tourism), while on the other is the resulting damage to marine resources and a reduction of the marine environment's natural capital (Patil et al. 2016).

The four negative human-induced or anthropogenic drivers of change in the WCR's marine natural capital are (1) overfishing, (2) coastal development and habitat degradation, (3) pollution, and (4) climate change and ocean acidification. These are mutually reinforcing drivers, which together with a range of other specific developments (such as introduction of invasive species like the lionfish from the Indo-Pacific) accelerate environmental degradation and threaten the region's economic stability and growth.

There is a "circular interaction" between economic sectors and the marine environment. The approximately US$57 billion generated annually from coastal tourism in the insular Caribbean depends heavily on these ecosystems and processes. Therefore, their degradation poses a serious threat to the sector (Figure 1.1.3). For example, use of the ocean for waste disposal and the resulting impacts on reefs, beaches, and mangroves and their services generate negative inputs to sectors such as tourism and recreation (Patil et al. 2016).

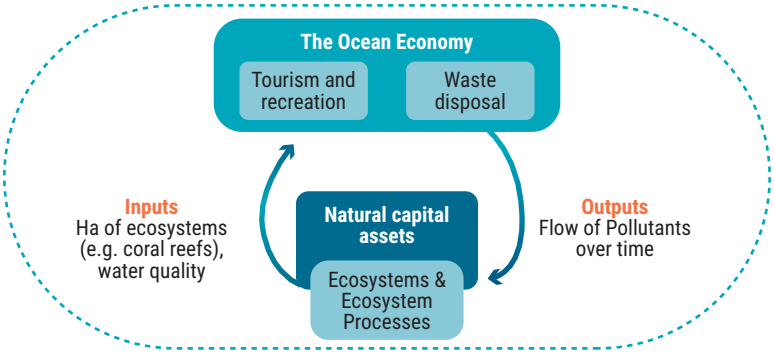
Overall, there is increasing global recognition of how badly the oceans are degraded and the need for collective and decisive action (Box 1.2.2) to reverse this trend. The WCR is no exception.

Figure 1.1.2 Two Parallel Trends in the Global Ocean



Source: Patil et al. 2016.

Figure 1.1.3 Blue Economy Linkages: Tourism, Waste Disposal, and Ecosystems



Source: Patil et al. 2016

Box 1.1.2 The need for collective action at the global level

The essential first step is ending the artificial dichotomy between economic demands and the health of our seas. We must put aside short-term national gain, to prevent long-term global catastrophe." This was the message of UN Secretary-General António Guterres at the 2017 Ocean Conference. He noted that numerous reports and studies have already documented the damage caused to our oceans and that "the situation is getting worse." Humankind has created these problems, he observed, and as such, it is our collective responsibility to solve them together with "decisive and coordinated action."

1.2 Marine Pollution is a Human Issue

Pollution is an externality that reduces the value of the goods and services provided by the oceans, both to specific countries and globally to the entire economy. Pollution of the marine environment is defined as the introduction "by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities" (Article 1(4), UN Convention on the Law of the Sea).

Pollution is the largest environmental cause of disease and premature death in the world today. In 2015, one in six deaths was linked to some form of pollution, with 1.8 million deaths arising from water pollution alone (Landrigan 2017). Marine pollution may affect human health when people have direct contact with pollutants or eat marine life and products contaminated by heavy metals, long-lived and harmful chemicals and materials, persistent organic pollutants, and other toxins that accumulate in the food chain (UN 2016 and MEA 2005). Beaches and seafood polluted with microbes can make visitors sick. The illnesses include stomach flu and gastroenteritis, skin rashes, pink eye, respiratory infections, meningitis, and hepatitis (NRDC 2014).

Unfortunately, pollution is now ubiquitous throughout the world's oceans, whether in the depths, the surface, or within marine life that inhabits the water. Most of this pollution is caused by direct or indirect dumping or discharges of solids and liquids from land-based sources such as rivers, marine outfalls,[3] waterways, runoffs, and infrastructure (GESAMP 2010). The rest enters the oceans from vessels and the atmosphere (UN 2016).

Excess nutrients and waste from agriculture and untreated sewage are common in all oceans. These have increased roughly threefold from pre-industrial levels, creating about 500 separate low-oxygen "dead zones"[4] that, by 2010, covered 245,000 square kilometers of ocean (Doney 2010). Some of these zones are within the WCR (Altieri et al. 2017). Solid waste, sedimentation, and toxic by-products from industries, including mining and oil exploration, are also contributing to the deterioration of marine ecosystems, in synergy with warming waters and acidification of oceans due to climate change.

Although countries have made considerable progress in limiting some forms of pollution, others such as marine litter persist, and in ever-growing volumes. Massive patches of floating debris, made up of small plastic particles or "microplastics," have been observed in the oceans since 1997. A huge one bigger than Mexico (more than 2.5 million square kilometers) was recently discovered in the Pacific off the coasts of Chile and Peru (Montanari 2017). The accumulation of marine litter on beaches and coastal areas has a profound impact on ecosystems—and aesthetics, with concomitant damage to tourism and a region's "brand."

Because 80 percent of all marine pollution in the Caribbean region comes from land-based sources, mostly untreated wastewater, litter, and agricultural run-off (UNEP-CEP 2010, 2014 and UNEP-GPA 2016), this report will focus on these three major sources of marine pollution. To a lesser extent, it will examine other forms of pollution, such as those arising from shipping, and industrial pollution such as oil, heavy metals, and toxic chemicals.

3 A marine outfall is a pipeline or tunnel that discharges municipal or industrial wastewater, stormwater, or combined sewer overflows into the sea.
4 Dead zones are areas with oxygen levels too low to sustain marine life, including commercial species, and cause the collapse of the local ecosystem.

The Ocean Agency

CHAPTER 2

Marine Pollution: Impacts and Threats to the Blue Economy

Caroline Power Photography

The Caribbean region is a unique collection of continental and island nations, encircling the Caribbean Sea and lying adjacent to the Gulf of Mexico. It covers a marine area of approximately 2.75 million square kilometers (Figure 2.1.1). Though its ocean is only one percent of the world's total, it supports the economies of 37 distinct geopolitical entities. These include large countries such as Mexico, Colombia, and Venezuela; the Central American countries of the Caribbean basin; the world's largest grouping of Small Island Developing States; and territories of the United States, the United Kingdom, the Netherlands, and French overseas departments.

2.1 The Marine Environment of the WCR

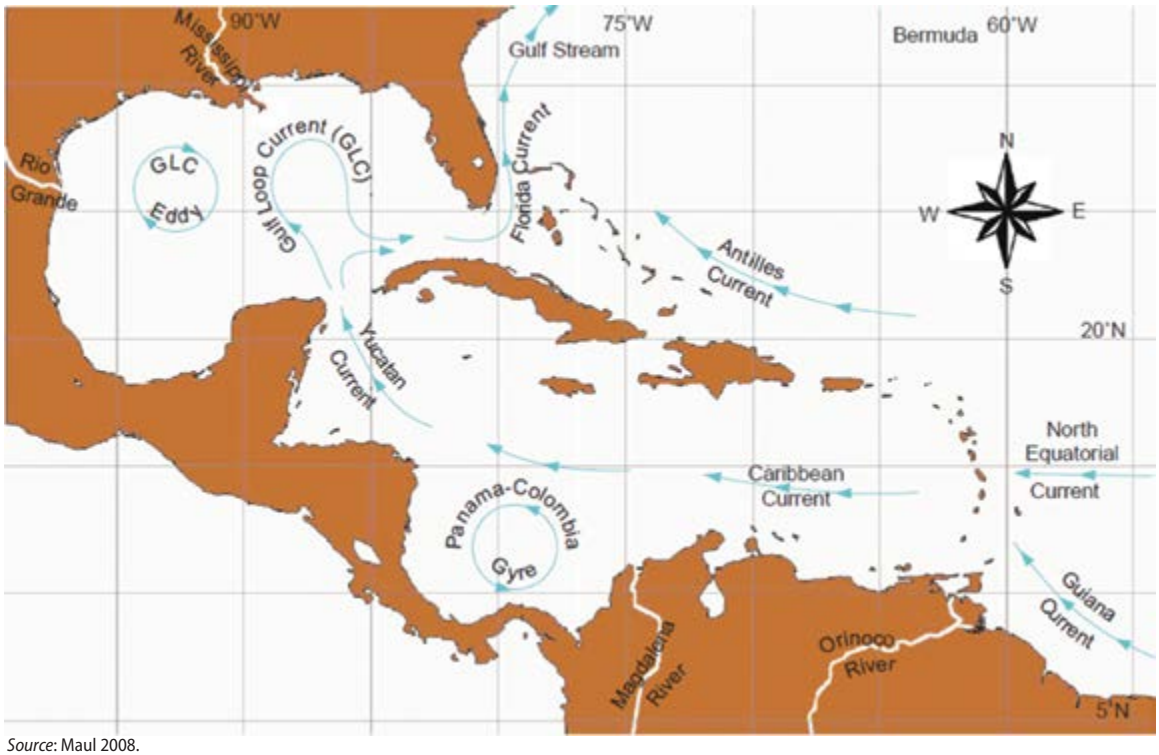
The hydrography of the Caribbean region is key to causing the transboundary effects of marine pollutants in the region. The Caribbean Sea is dominated by the flows of the North Equatorial Current and, to a lesser extent, the South Equatorial Current, which together with the North Brazil and Guiana Currents form the "Caribbean Current" (Fig.2.1.2). The Caribbean Current transports significant amounts of water northwestward through the Caribbean Sea and into the Gulf of Mexico, via the Yucatan Current. In addition, two major gyres flow counter-clockwise off Colombia and Panama and south of western Cuba. The Caribbean Current enters the gulf via the Yucatan Channel and exits to the east through the Straits of Florida as the Gulf Stream (Gyory et al. 2013). The currents assure that marine pollution doesn't stay in one place but gets propelled all over the region.

Watersheds of rivers and canals send large volumes of freshwater flowing into the WCR basin and hence are very important engines of land-based marine pollution (UNEP 2016). The largest contribution of fresh water into the WCR comes from the Amazon River (on average 250,000 cubic meters per second), creating an enormous plume that extends northwest hundreds of kilometers. Drifters deployed near the river's mouth throughout the year move toward the Caribbean in one to six months, depending on the season (Gyory et al. 2013). The Orinoco River is the second-largest source in the south. To the north in the Gulf of Mexico, meanwhile, the largest freshwater contribution comes from the Mississippi River (approximately 16,800 cubic meters per second).

Figure 2.1.1 The Wider Caribbean Region

Source: Adapted from UNEP-CEP 2010.

Figure 2.1.2 The Currents of the Wider Caribbean Region



Source: Maul 2008.

The Caribbean encompasses an important global hot spot of marine biodiversity and is the most geographically and oceanographically isolated tropical ocean on the planet (Jackson et al. 2014). This isolation makes its marine biodiversity unique. The Wider Caribbean Region is a large marine ecosystem (LME) that nurtures a high diversity of flora and fauna. With 12,000 reported species, the Caribbean is among the top twelve world hotspots in terms of biodiversity (BirdLife 2010).

The region's coastal zones host rich and unique habitats that include coral reefs, seagrass beds, mangroves, and salt ponds. Other life forms making their homes there are reef and pelagic fish, lobsters, conch, turtles, algae, and resident and migratory birds. Offshore waters are home to numerous species of marine mammals and sea turtles as well as deep water pelagic fish. These coastal resources provide the basis for a range of economic and social activities, including the tourism and fishing industries. This rich biodiversity, which is partly due to isolation within the Caribbean Sea, has resulted in the greatest concentration of rare and endemic marine species in the Western Hemisphere.

Within the WCR, the Eastern Caribbean ranks among the world's top five biodiversity hot spots due to its marine and coastal ecosystems. Many of these ecosystems, however, are over-exploited and under-protected.

2.2 Economic Contribution of the Caribbean Sea

The marine environment makes a huge contribution to the overall economy of Caribbean countries. Tourism and fishing play a dominant role, along with maritime transport (Patil et al. 2016). There are also strong cultural attachments to coastal resources and their uses.

Fisheries

The fisheries sector in Caribbean countries is a large source of nutrition, employment, and foreign exchange, as well as contributing to social and economic stability. During the 2013-2014 period, total capture fish production averaged 162,220 mt across Caribbean Regional Fisheries Mechanism (CRFM) member states. The value of marine capture fisheries production and aquaculture fisheries was US$ 460 million annually over the period. The total number of persons employed in the fisheries sector was estimated at 341,668, representing 4.3% of the workforce of the region (CRFM 2015). In view of heavy fishing in recent years, few large

surplus stocks remain in the Caribbean region, with the exception of the waters of Guyana, Suriname and, to a lesser extent, Belize (ITLOS 2013). Coastal fisheries in particular have declined sharply in some countries in recent years. In some places, the tourist market for fish products is particularly important, with foreign visitors consuming a large portion of the domestic market's fish.

Tourism

Caribbean economies are known to be the most tourism-dependent in the world (CLME 2011). Tourism is a significant economic activity, accounting for 15 percent (WTTC 2018) of the region's GDP. While less than 1 percent of the world's population lives in the region (excluding the United States and Mexico), the region receives 6 percent of the world's tourists. Tourism is the dominant source of employment and foreign exchange and has, since the 1990s, helped to offset a decline in agriculture and agricultural exports. Countries such as Dominican Republic, Grenada, and Jamaica are particularly dependent on tourism, which accounts for more than 70 percent of their total services exports, and this figure reaches 80 percent for countries such Bahamas and Saint Lucia (UNEP 2016). The expected growth in tourism, which mostly takes place in coastal and marine areas, will put increasing pressures on the Caribbean Sea ecosystem and natural assets.

Maritime Transport

More than 90 percent of global trade travels by sea. Caribbean island nations, in particular, are almost entirely reliant on shipping to support their economies. By 2050, maritime freight transport is projected to quadruple from 2010's levels (OECD and ITF 2015). The Caribbean Sea is also a major global shipping route due to the large number of vessels converging on and departing from the recently expanded Panama Canal.

Emerging Industries

In the transition to a Blue Economy, more and more countries are looking to the ocean for new types of industries. Marine economic activity is set to shift dramatically in the coming decades, according to the Organisation for Economic Co-operation and Development (OECD). Emerging industries will include offshore wind, tidal, and wave energy; oil and gas exploration and production from previously inaccessible waters; offshore aquaculture; seabed mining; and marine biotechnology. The new activities could help address many of the challenges that will face the world population in coming decades, from food insecurity to the search for new sources of energy and jobs (OECD 2016). The key task in the WCR will be to manage the shift in such a way as to foster more sustainable "blue growth" without bringing additional pressure (such as pollution) to the existing natural capital assets of the region.

2.3 Critical Challenges Facing the WCR

The small island countries in the WCR face unique challenges to their growth and development. These include small land mass, continued reliance on a small number of major export products with associated vulnerability to economic shocks; poorly developed waste management infrastructure; the location of most of their people along coastlines; and greater vulnerability to natural events.

The economies of these countries are being battered by some of the worst storms on record. Over 90 percent of natural disasters in the insular Caribbean between 1970 and 2011 were extreme weather events, primarily storms and hurricanes, followed by flooding (UNEP 2016). The hurricanes which struck the insular Caribbean during 2017 were among the worst on record (John 2017). Hurricane Irma was the most powerful Atlantic hurricane in history and had the second-longest duration as a Category 5 hurricane. It had catastrophic impact on the island of Barbuda, damaging or destroying 90 percent of its infrastructure (Horsford 2017). Hurricane Maria was devastating for Dominica and Puerto Rico. The IMF has estimated that based on current trends, climate change could increase storm costs to the Caribbean by as much as 77 percent by 2100. Moreover, these events worsen marine pollution by increasing the vulnerability of ecosystems and the amounts and dispersal of waste and pollutants.

Rapid rates of urbanization in the Caribbean are placing new pressure on water and sanitation services. At the onset of the millennium, 62 percent of the region's people lived in urban areas. This increased to 70 percent in 2015 and is projected to reach 74 percent in 2025 (UNEP 2016). Consequently, the delivery of important services such as water and sanitation will continue to challenge governments in the region. With 45 million people living within 30 kilometers of a coastline (Burke et al. 2011) and 90 million within 100 kilometers (UNEP 2016), there is high anthropogenic pressure on coastal and marine resources.

2.4 Impact of Pollution on the Natural Valuable Capital of the WCR

Coral reefs, seagrass beds, and mangroves are interlinked marine ecosystems that are critical for the sustainability of major economic activities such as tourism, fisheries, and transportation. However, these same ecosystems are being severely degraded by overuse and anthropogenic impacts, resulting in loss of revenue, livelihoods, and biodiversity.

Box 2.4.1 The Decline of Coral Cover in the Caribbean

Coral cover in the Caribbean has declined dramatically since the early 1980s, with 1999 to 2011 described as the "modern era of massively degraded coral reefs" in the Caribbean (Jackson et al. 2014). Average coral cover in the Caribbean in 2011 was estimated at 14.3 percent—a decline of almost half since 1970. In some areas, coral cover is down by 80 percent (Jackson et al. 2014).

Reef degradation is probably the single most serious threat to the natural capital of the Caribbean. It is already costing an estimated annual revenue loss of between US$350 million and US$870 million. If this trend continues, the reefs' value to the economy will have decreased by the year 2050 by between 11 and 19 percent (Burke and Maidens 2004, Burke et al. 2011). Land-based sources of pollution account for about 20 percent of these impacts. That means that by 2050, land-based pollution impacts on coral reefs in the region could have economic costs of up to US$172 million, and potentially even more.

Box 2.4.2 Economic Value of Caribbean Coral Reefs

The economic value of Caribbean coral reefs was estimated over a decade ago at between US$3.1 billion and US$4.6 billion. These figures were based on the goods and services these ecosystems provided for the year 2000 for fisheries, dive tourism, and shoreline protection. Dive tourism alone generated US$2 billion in revenue (Burke and Maidens 2004).

After overfishing[5], sediments and pollution from inland sources are the biggest threat to reefs. This represents US$525 million per year of lost environmental services in areas under medium threat of pollution and US$700 million per year for places facing high threat, for a total of US$1.2 billion (Annex 2). These costs are concentrated in Belize, Colombia, Cuba, the Dominican Republic, Haiti, Jamaica, Panama, and Puerto Rico (Burke and Maidens 2004).

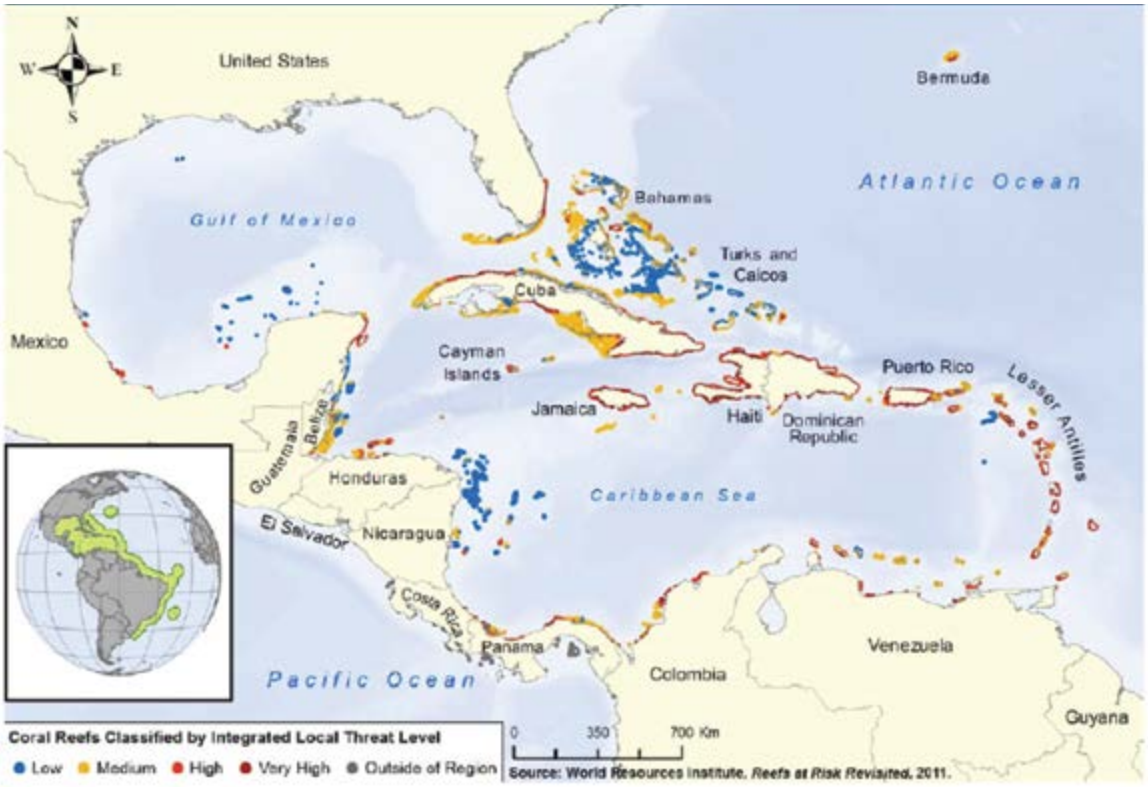
Pollution can harm coral reefs in ways that are only now being documented and understood. For example, recent studies have indicated that plastic debris may increase the incidence of coral disease (Lamb et al. 2018), while eutrophication caused by agricultural run-off and sewage outflows has been linked to hypoxic zones in deeper water, resulting in coral bleaching at non-stressful temperatures (Altieri et al. 2017). In addition to nutrients, sewage outflows may contain freshwater, pathogens, endocrine disrupters, heavy metals, and suspended particles (Wear and Vega Thurber 2015). These have all been associated with coral mortality rises, disease, suppressed growth and reproduction, and coral bleaching (Wear and Vega Thurber 2015). Coral reef degradation from overfishing and pollution, meanwhile, increases under the impacts of climate change, such as bleaching, disease, acidification, and damage by stronger storms and hurricanes.

Another major threat to coral reefs is coastal development. This represents costs of US$596 million per year in medium-threat locations and US$561 million per year in high-threat places. These costs are concentrated in countries including Haiti, Cuba, the Dominican Republic, Jamaica, and Puerto Rico (Burke and Maidens 2004).

Beaches directly suffer due to coral reef degradation, because corals are a source of much of the calcareous sand and provide protection from waves. The cost of artificially replacing sand, a process known as beach nourishment, can run into millions of US dollars for a single island. The cost of *not* replacing the sand, however, can be even higher in terms of lost tourism revenue. Conversely, protecting the reef is much more cost-effective. Beaches are also severely harmed by litter. Studies have suggested the greatest economic loss caused by reef degradation comes from reduction of amenities and tourism revenue (Rangel-Buitrago et. al. 2018 and Williams et. al. 2016).

5 Overfishing harms reef by removing fish that eat bacteria that otherwise would smother coral

Figure 2.4.1 Reefs at Risk in the Wider Caribbean Region



Source: Burke et al. 2011

Seagrass beds and mangroves are also critical for the Caribbean's environmental sustainability. Seagrass beds get little recognition for the contribution they make to key services, including fisheries (directly) and tourism (indirectly). The beds produce sand, protect beaches from wave action, and nurture wildlife, an important part of eco-tourism and fisheries (CARSEA 2007). Threats to seagrass beds in the Caribbean include pollution from nutrients, such as nitrogen, which causes excessive growth of epiphytes (other plants that grow on the grass blades). Nutrient pollution can also overstimulate the growth of the seagrass itself, leading to difficult decisions to clear beds that expand into previously clear sandy areas. High sediment loads have also harmed seagrass ecosystems, including in Cartagena Bay, where seagrass has practically disappeared (Restrepo et al. 2006).

Mangroves shelter almost all coastlines in the region, providing important socioeconomic and environmental functions (Box 2.4.3). Studies of pollution impacts on mangroves in the Caribbean indicate that oil spills are the main threat to these ecosystems, causing large die-offs of trees and benthic organisms. Other pollutants damaging mangroves include mercury and other chemicals released from bauxite mining, pesticides, sewage, and heavy metals from industrial activities. The nature of the impacts varies: pesticides have toxic effects on mangroves, stunting their growth or killing them, while sewage discharges result in fungal infections that kill or impair the trees. Solid waste also shows severe effects on mangrove forest health and natural regeneration. A study in Jamaica, for example, has shown that mangrove seedling exposed to higher solid waste cover were shorter and less productive, with plastic bags causing harm to seedling survival (UWI Mona Campus Research Days 2018).

Box 2.4.3 Socioeconomic and Environmental Functions of Mangroves

Mangrove forests and seagrass beds are nursery grounds for fisheries and protect shorelines against wave and wind action. They act as natural filters to remove harmful pollutants, absorb nutrients from runoff, and trap sediments, helping to increase the clarity and quality of marine waters. Mangroves can generate income as eco-tourist attractions for the viewing of birds, manatees, crocodiles, and other fauna and flora. But the building of ports, harbors, marinas, and tourism infrastructure, and cutting them for production of charcoal has degraded or destroyed many of these systems (UNEP 2016) and compromised the services they provide. Local communities and artisanal fishers can feel the effects particularly hard. For instance, loss of mangroves has decreased the availability of shrimp larvae and consequently shrimp production has fallen (UNEP 2016). Six countries of the WCR are among the top 20 worldwide with highest mangrove coverage, with Cuba being the only island nation among them. Collectively, these six countries represent 14% of the mangroves in the world (Hamilton and Casey 2016).

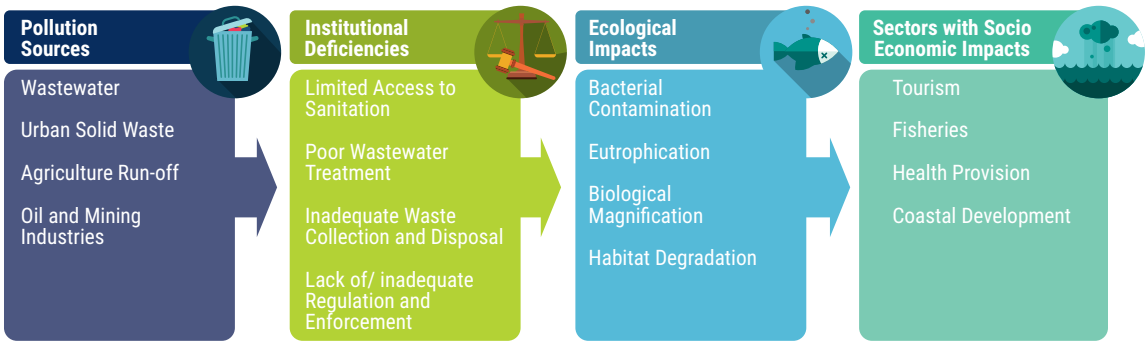
These three habitats—mangroves, seagrass beds, and coral reefs—must be considered as one large interdependent ecosystem with shared biodiversity. Degradation of one type of habitat can have far-reaching impacts on the services that human communities receive from another. For example, overfishing has been the single most damaging activity for reefs (Jackson et al. 2014) because it removes fish that eat algae that smother corals. This not only hurts the reef but tourism and beach nourishment as well. Likewise, the clearing of seagrass beds for aesthetic reasons in bathing waters could affect income from fisheries and, in the long run, speed up erosion of nearby beaches, which would reduce the appeal to tourists and damage local livelihoods. Other ecosystem impacts of pollutants include harm to fish and communities of species that live on the ocean floor. For example, toxins from industrial discharges can cause die-offs of seabed species, while bacteria from sewage discharges can contaminate seafood (Elison and Farnsworth 1996).

The ecological impacts on the natural capital are significant, and so are the socio-economic impacts. Climate change and climate variability amplifies many of these impacts. Figure 2.4.2 summarizes the pollution impact chain and identifies the priority concerns in the Caribbean region. The prioritization takes into account the current or potential value of the socioeconomic sector affected and the degree to which pollution can degrade that value. Where quantification is not available, the extent of reports on impacts is used as a qualifying factor for prioritization (that is, many reports spread across the region would constitute a higher priority than highly localized impacts). These linkages have also been recognized by WCR governments under the CLME+ concept to support stress-reduction measures under an ecosystem management approach.

The ecological impacts from pollution and the associated socioeconomic costs are caused in part by local or regional institutional factors that are common in the region. Among the most important institutional deficiencies are:

- Low percentage of treated water
- Lack of access to safe sources of drinking water and inadequate discharge of black and gray water, particularly among low-income households
- Inadequate or non-existent systems for collection, recycling, and disposal of urban and industrial waste

Figure 2.4.2 Linking Pollution with Drivers and Impacts in the WCR



- Lack of/inadequate regulation and monitoring of agricultural and industrial production and disposal of hazardous pollutants, in particular from the oil and the mining industries

These ecological impacts result in economic impacts in the following four sectors:

- **Human health.** Countries in the WCR still face important challenges in terms of treatment of curable diseases that are linked both to exposure to unsafe drinking water and to inadequate systems of water disposal, particularly in rural areas. Discarded litter can provide a reservoir for stagnant water providing breeding ground for mosquitos and flies that spread diseases to humans such as Malaria, Dengue Fever, and Chikungunya virus. In addition, there are health risks associated with the consumption of marine species that contain high concentrations of chemicals, heavy metals, or pesticides due to biological magnification processes in marine food chains. Further research is needed on the impacts of microplastics (ingestion) to humans.

- **Fisheries.** Impacts to fisheries can be both direct and indirect. Direct impacts relate to reduced rates of survival of commercial species in polluted marine habitat. Also, species that are contaminated with chemicals and heavy metals result in several health concerns that reduce the commercial value of catches. Indirect impacts relate to reduced productivity in nurseries, such as mangroves, sea grass beds, and coral reefs, and, in general, to reduced quality of the pelagic marine habitat.

- **Tourism.** Marine pollution causes aesthetic degradation of such natural assets as beaches, sand dunes, coral reefs, and mangroves. Reduced visitation rates not only affect tourism-oriented economic units, but have a negative widespread indirect effect on the rest of the regional economy, because the supply chain for tourism includes sectors throughout the economy, from food production and manufactures to specialized services.

- **Coastal protection.** Pollution and habitat degradation can also harm coastal infrastructure, in particular through the value of coastal real estate. Coastal property can acquire high economic value due to its hedonic valuation. However, beach pollution and degradation of coastal habitat can reduce the hedonic component of property value. Higher environmental risk and higher costs of property insurance due to higher exposure to the wind and wave action associated with degradation of sand dunes, mangroves, and coral reefs can further drive down the economic value of coastal infrastructure.

CHAPTER 3

Assessing Marine Pollution in the WCR

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The main sources of marine pollution are influenced by coastal population sizes. There is a direct relationship between the volume of pollution entering the region's oceans and how many people live along the coasts and the watersheds draining into the oceans. In the WCR, the largest populations live in the watersheds and coastlines of Mexico and Colombia, along the Gulf of Mexico and Caribbean Sea. It is recognized that marine pollution is expected to grow with increasing population and rising per capita consumption (Kaza et. al, 2018).

A second factor affecting pollution is the level of waste management systems in the region. Cities along the coast are particularly problematic sources of untreated wastewater and litter due to inadequate waste collection, disposal, and treatment facilities. Solid waste that ends up in the marine environment often gets there through water drainage systems that have acquired an unintended function of removing waste from urban areas. Once it enters the waterways and marine environment, it conveniently escapes the direct responsibility of the local authorities and individual citizens but becomes an important concern to the coastal and marine environment. The quantity and timing of this waste load is influenced by the interrelationship between hydrologic and climatic conditions; the quality and coverage of waste collection services, street sweeping and other cleaning services; and the level of maintenance and design of drainage systems. In addition, direct littering of coastal areas which have recreational and other activities and direct dumping into coastal and marine environment are other common sources of solid waste pollution. In sum, improving waste management systems remains a major challenge in the WCR[6], especially for Caribbean SIDS, which are also vulnerable to the waste generated by international shipping. Countries that manage and plan for safe waste disposal will benefit from a cleaner environment which can in turn improve international investment, tourism, and economic growth.

Figure 3.1.1 A Shocking Sea of Plastic Floating Near the Caribbean Island of Roatan

Photo by Caroline Power Photography.
Source: The Telegraph News, 26 October 2017.

6 The OECS Solid and Ship Generated Waste Management Project which established landfills ended in 2003. It was intended to protect public health and maintain the integrity of the terrestrial and marine environments including compliance with the "Special Area" designation of the Caribbean Sea. Given the period since initial implementation, it may be necessary to assess whether the project goals were achieved; and, if the technologies and approaches employed are still relevant, functional, efficient, and appropriate to reduce current waste generation, and address new and emerging challenges.

In terms of magnitude, the main pollutants in the WCR include marine and coastal litter, untreated or partially treated wastewater; and agricultural run-off collected by river systems and sent to the ocean. Industrial pollutants, heavy metals and discharges, and waste from shipping are not as widely documented in the region but are potentially as important, given the magnitude of those sectors.

3.1 Marine and Coastal Litter

Litter and debris are a common sight in the region's marine and coastal areas, sometimes covering vast expanses of water. In 2017, a mass of floating trash at least eight kilometers wide and several kilometers long was found off the coast of Honduras (Figure 3.1.1), apparently caused by heavy rains and discharge from rivers (BBC 2017).

Volunteer cleanups have found the Caribbean contains several times more litter than the global average. The 2017 International Coastal Cleanup organized by the Ocean Conservancy is an aggregation of voluntary cleanups of large numbers of local coastal areas. As participation is global, the data of what they found provide a useful snapshot of the level of litter in coastal areas.[7] For selected countries featured in this report and areas subject to coastal cleanup, an average of 2,014 litter items per kilometer were found on beaches and coastal areas as compared to a global average of 573 (Table 3.1.1). The top marine litter found was plastic bottles (21%), in addition to other single use plastic items, and foam containers.

Litter is accumulating in the Caribbean Sea. Studies have measured the concentration of plastic across the Caribbean Sea and found as many as 200,000 pieces of plastic[8] per square kilometer in the northeastern Caribbean (Table 3.1.2). Marine litter in this hotspot has been found to originate from the Caribbean as well as from northern waters (Law et al. 2010) and is believed to be brought to the area by the prevailing currents. SIDS are often exposed to concentrations of plastic litter that are disproportionate to their own consumption and population (Lachmann et al 2017).

Table 3.1.1 Litter found in coastal cleanups in selected Caribbean countries

Country	Km of Coast surveyed	Litter Concentration (items/km)	Common litter items (Items per KM)					
			Plastic beverage bottles	Plastic bottle caps	Plastic grocery bags	Plastic lids	Straws-stirrers	Foam food containers
Belize	48	1914	157	101	85	30	86	26
Jamaica	151	4684	1497	509	115	70	63	125
Cuba	2	601	4	38	30	8	15	13
Dominican Republic	117	3966	394	30	116	74	173	3
St Kitts and Nevis	6	1050	394	135	5	47	20	30
Barbados	44	1260	97	126	22	14	45	15
St Vincent and the Grenadines	4	2435	623	76	102	24	24	84
Grenada	1	543	110	9	23	0	10	0
Trinidad and Tobago	13	1636	351	151	25	25	31	44
Guyana	4	3904	1086	448	50	79	200	84
Suriname	1	160	31	11	25	0	0	1
Average (Caribbean)		**2014**	431	148	54	34	61	39
Average (Global)		**573**	65	34	22	17	17	15

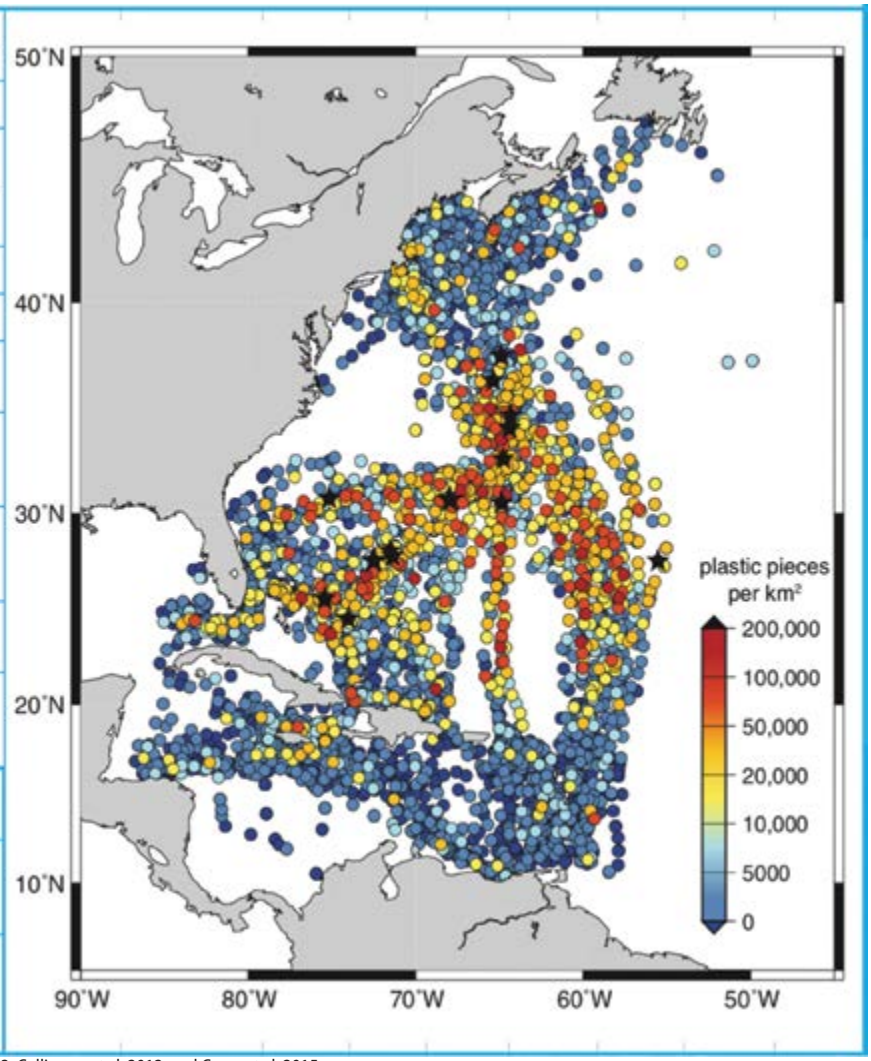
Source: Ocean Conservancy 2017.

7 Ocean Conservancy, 2017. The litter concentrations along the beaches is an indicative number that provides useful relative information, but not an absolute final concentration and does not represent all beaches in a given country. This is because the calculated concentration is a function of the number of people involved in the efforts, and of the choice of the site itself.

8 Plastic pieces reported along the Caribbean Sea, and in other regions, vary in size and density depending on how long (time and distance) they have been free-floating. The measures reported are for plastic pieces visible to the naked eye and counted by hand.

Table 3.1.2 Plastic Collected across the Caribbean Sea

Estimated site surveyed	*Plastic concentration (items/km2)*
Concentrations in between islands	0 - 4,000
Concentrations in the North Eastern Caribbean (off the coast of the Bahamas)	20 - 200,000
Concentrations off the coast of Jamaica	100,000
Concentrations off the coast of Haiti	100,000
Concentrations off the coast of Dominican Republic	50,000
Concentrations off the coast of St. Kitts and Nevis (Caribbean Sea)	10,000
Concentrations off the coast of Dominica and Martinique (Atlantic)	15000
Concentrations off the coast of Barbados (Atlantic)	50,000
Concentrations off the coast of Trinidad and Tobago (Atlantic)	17,000
Reported Average Concentrations in the Caribbean Sea	***1,414***
Reported Average Concentrations in the Mediterranean Sea (for comparison)	116,000 - 250,000
Reported Average Concentrations in the waters around Australia (for comparison)	4,256

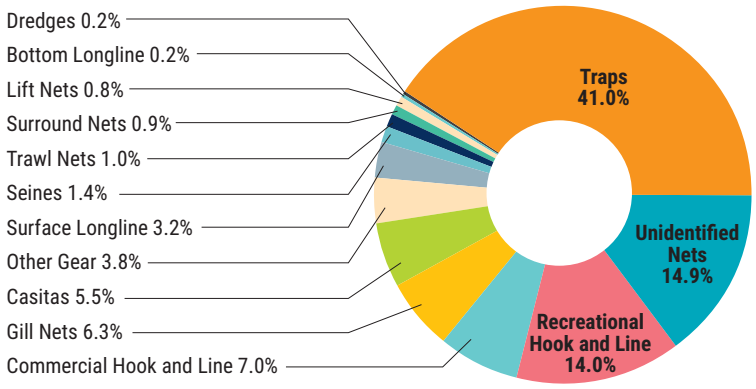


Source: Law et al. 2010, Reisser et al. 2013, Collignon et al. 2012, and Cozar et al. 2015.

Figure 3.1.2 Crabs Caught in an abandoned, lost or otherwise discarded fishing gear (ALDFG), in this Case a Gill Net

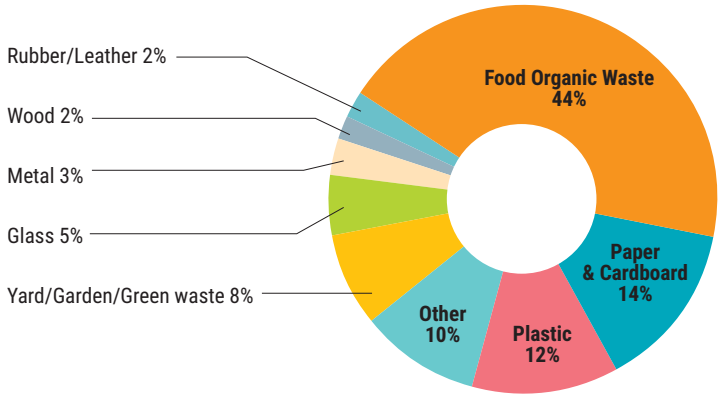
.Photo by Frank Barnsah.

Figure 3.1.3 Type and Relative Contribution of Fishing Gear Reported as ALDFG in the Caribbean



Source: Matthews 2009

Figure 3.1.4 Average Proportion of Waste Composition Generated in Selected WCR Countries



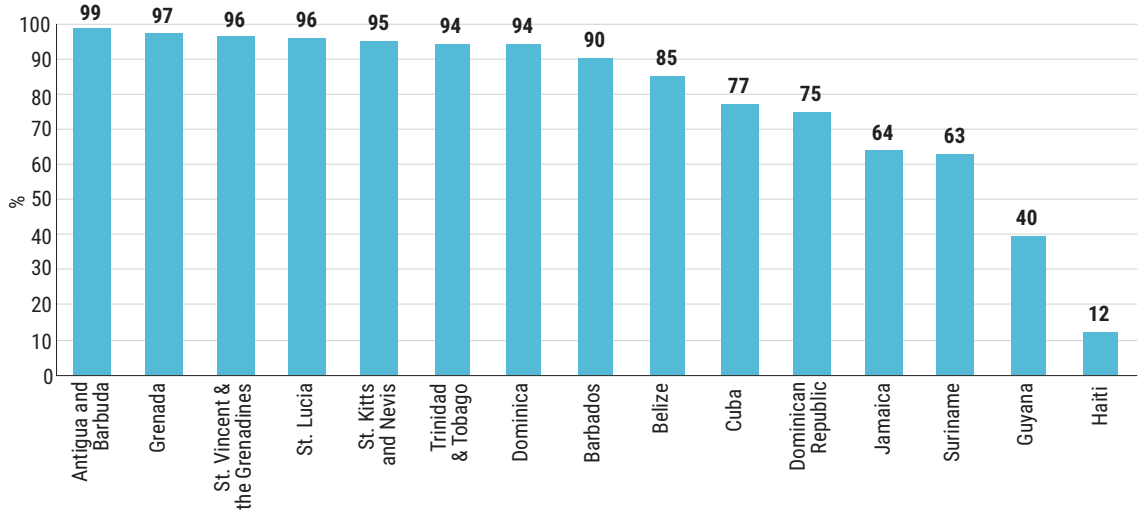
Sources: Belize waste characterization study 2016 (BSWMA); St. Lucia waste characterization study 2008 (SLSWMA); GIZ 2016 (Reducing the input of plastic litter into the ocean around Grenada); Jamaica waste characterization study 2013 (JNSWMA); Richards 2002 (St. Vincent and the Grenadines waste characterization study); Trinidad and Tobago Environmental Management Authority 2011.

Abandoned, lost, or otherwise discarded fishing gear (ALDFG) is another important type of marine debris. Fishing gear (lines, traps, nets, etc.) and aquaculture structures are discarded or otherwise lost due to wear and tear, cut by anchor ropes, storms, or boating accidents (Figure 3.1.2). ALDFG is considered the main source of plastic waste in the marine environment coming from the fisheries and aquaculture sectors (FAO 2016). A Caribbean study reported that the majority of ALDFG was found underwater (60 percent), and traps were the most common type of gear (41 percent), followed by various types of nets (25 percent) (Matthews, 2009; Figure 3.1.3). This is worsened by severe weather common in the WCR. Derelict fishing gear floating on the ocean surface or resting on the ocean floor can continue for a long period of time to trap non-target organisms, a process known as ghost-fishing (Lusher et al. 2017 and NOAA 2015).

Solid Waste Management and Marine Litter in the Caribbean

While plastic represents only a fraction of the solid waste that is generated, it is a major constituent of marine and coastal litter. Waste generated in the Caribbean on average contain 12 percent plastic (Figure 3.1.4). However, plastic is resistant to degradation relative to other forms of solid waste. Data from beach and coastal clean-ups in 2017 indicate that plastic beverage bottles alone amount to 21 percent of the items recorded, and when combined with other common plastic items, 35 percent of the items are single source plastic. Global studies have also shown

Figure 3.1.5 Percentage of Households with Waste Collection Service in the Insular Caribbean



Sources: Dominican Republic 2010 National Census (Dominican Republic National Statistics Office, 2011); Jamaica 2011 National Census (Statistical Institute of Jamaica, 2011); Trinidad and Tobago 2011 National Census; St. Lucia 2010 National Census (Saint Lucia Central Statistics Office, 2011); Grenada 2011 National Census (Grenada Central Statistics Office, 2011); St. Vincent and the Grenadines 2012 National Census (SVG Ministry Of Finance And Economic Planning, 2012).

that plastic dominates litter in marine systems (up to 80 percent) (Kaza et. al, 2018) and is commonly found ingested by animals (Boucher and Friot 2017).

The Caribbean countries that produce more waste have larger gaps in household waste collection services. Between 90 and 95 percent of households in Eastern Caribbean countries are covered by collection services.[9] However, the coverage diminishes for the larger countries in the Caribbean. Cuba, the Dominican Republic, and Jamaica all have collection coverages between 60 and 80 percent while Haiti the figure is only 12 percent (Figure 3.1.5). In that country alone, more than 1.6 million tons of solid waste goes uncollected each year (Table 3.1.3). Of the uncollected waste in the 15 countries shown in Table 3.1.3, plastic waste makes up an estimated 322,745 tons each year.[10]

Box 3.1.1 Why Plastic Litter is So Harmful to the Coastal and Marine Environment

Plastics are persistent. Plastics take years to breakdown chemically even in the conditions in the marine environment. For most plastic items, even if they disintegrate due to weathering, the polymer itself may not fully degrade into natural chemical compounds or chemical elements under marine conditions (UNEP 2015).

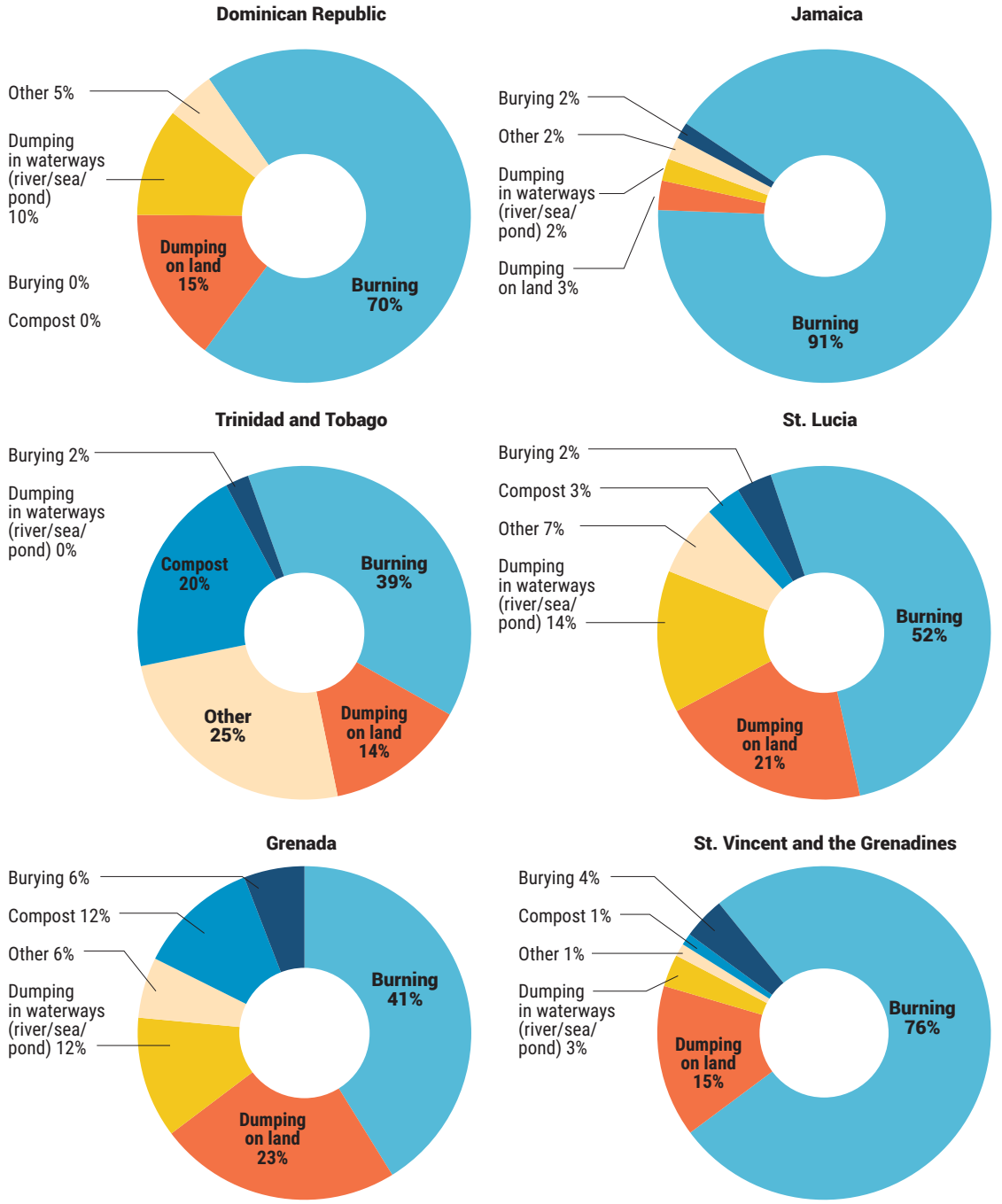
Plastics break down into smaller fragments in the marine environment. Small plastic particles or "microplastics" are commonly found in cosmetics and cleansers. These are also formed in the marine environment when large pieces of plastic break down structurally, forming small fragments.

Pesticides and organic pollutants such as PCBs can accumulate on plastics. Due to the chemical properties of plastic, persistent organic pollutants—chemicals that accumulate through the food chain—adsorb to plastics in the marine environment. Many of these pollutants have toxic and carcinogenic properties. Additives to plastics may also be contributing to the potential pollutants associated with plastics in the environment.

Plastics interact with marine life. This happens directly through entanglement, ingestion, and in some cases integration into the organism. For the latter two issues, microplastics are of particular concern due to their ease of ingestion.

9 Countries include Antigua and Barbuda, Grenada, St. Vincent and the Grenadines, St. Lucia, St. Kitts and Nevis, and Dominica.
10 These numbers are estimated based on the reported waste composition for each country. Reported plastic proportions range from 5 to 20 percent.

Figure 3.1.6 Waste Management Practices of Households without Collection Service



Sources: Dominican Republic 2010 National Census (Dominican Republic National Statistics Office, 2011); Jamaica 2011 National Census Statistical Institute of Jamaica, 2011); Trinidad and Tobago 2011 National Census; St. Lucia 2010 National Census (Saint Lucia Central Statistics Office, 2011); Grenada 2011 National Census (Grenada Central Statistics Office, 2011); St. Vincent and the Grenadines 2012 National Census (SVG Ministry of Finance and Economic Planning, 2012).

A significant proportion of uncollected household waste ends up in coastal and marine systems. Households that do not have collection service often resort to dumping it directly in waterways or on land where it can be washed into drainage systems or waterways. Based on data from six Caribbean countries (Figure 3.1.6), an average of 22 percent (with a range of 5-35 percent) of households without collection service dispose of waste in these two ways, with 7 percent (0-14 percent) placing waste directly in waterways. The most common disposal method (62 percent average, 39-91 percent) for households without collection ser-

Table 3.1.3 Total Uncollected Household Waste and Plastics in Selected Countries of the Insular Caribbean

Country	Uncollected household waste (tons/year)	Uncollected household plastic (tons/year)
Haiti	1,673,750	93,730
Dominican Republic	1,020,042	102,004
Cuba	619,534	55,758
Jamaica	358,605	43,750
Guyana	72,660	14,387
Suriname	29,599	3,848
Trinidad and Tobago	27,923	5,353
Belize	8,935	1,698
Barbados	8,174	1,398
St. Lucia	1,408	310
St. Kitts and Nevis	1,026	238
Grenada	622	102
St. Vincent and the Grenadines	580	49
Dominica	530	85
Antigua and Barbuda	295	35
TOTAL	3,823,683	322,745

Sources: Dominican Republic 2010 National Census (Dominican Republic National Statistics Office, 2011); Jamaica 2011 National Census Statistical Institute of Jamaica, 2011); Trinidad and Tobago 2011 National Census; St. Lucia 2010 National Census (Saint Lucia Central Statistics Office, 2011); Grenada 2011 National Census (Grenada Central Statistics Office, 2011); St. Vincent and the Grenadines 2012 National Census (SVG Ministry of Finance and Economic Planning, 2012). The waste characterization studies were also used (see annex 6).

vice is burning. Because this method is inefficient in eliminating waste, ash and other remnants can be washed to coastal and marine areas.

Impacts of Coastal and Marine Litter

The path to the ocean is littered with impacts. Litter that ends up in the marine environment has impacts before it even reaches the ocean. After a household, company, or individual dumps or otherwise litters the environment, it is moved by the power of wind, rain, water flow among other means, polluting urban areas, roads, waterways, and beaches along the way. The litter impacts aesthetics, tourism, marine life, contributes to the risk of mosquito-born illnesses, and exacerbates flooding. These are described below.

Litter contributes to flooding, worsening the impact of heavy rainfall. Flooding in Kingston, Jamaica that caused millions of dollars' worth of damage was attributed to drains clogged with plastic bottles, bags, and Styrofoam (McLean 2016). In addition to this type of waste, paper, cardboard, tree and garden cuttings, medical and market waste, appliances, tires, and entire cars are illegally dumped (JET 2016). In 2015 garbage in Jamaica's South Gully, part of Montego Bay, included plastic bottles, plastic bags, fabric, motor oil, tree branches, appliances, tires, dead animals, and used condoms (JET 2016).

Litter is a habitat for mosquitoes and pests. Litter can serve as a receptacle for rainwater which serves as a breeding habitat for pests including those that carry disease. Litter that ends up on beaches, in drainage canals, and waterways, can carry some of the most harmful human viruses. Studies have shown that common litter items such as plastic bottles, tin cans, and Styrofoam containers account for between 7 and 15 percent of the breeding habitats for the mosquitoes that carry Dengue, Chikungunya and Zika (*Aedes aegypti* and *Aedes albopictus*). Due to their limited range of movement, these mosquitoes spread these diseases most effectively in densely populated areas, areas which also produce large amounts of waste.

While not the only or predominant factor, reduction of litter can reduce the risk of contracting these diseases, which are estimated to afflict more than 15 million people annually in the Caribbean during years of outbreaks and over

500,000 per year in other years.[11] Dengue fever is estimated to cost the region US$317 million per year (Shepard et al. 2011) and Zika US$716 million (UNDP 2017). Chikungunya, a debilitating illness that causes long-term symptoms including fever and joint pain, had a major outbreak in 2014 and is estimated to have cost the region as high as US$30 billion yearly (Bloch 2016). Since 2010, outbreaks of one or more of these diseases have occurred, on average, every other year, directly hurting the tourism industry as visitors avoid countries with the outbreaks. This is estimated to cost the region US$700 million per year in outbreak years, or 0.21 percent of GDP (UNDP 2017).

Litter found along beaches can harm a country's tourism product. Studies have shown that tourists are unwilling to return to areas with poor water quality and degraded beaches. Schumann et al. (2017) reported that tourists in Barbados indicated strong preferences for clear water, healthy coral reefs, and high-quality beaches—all of which may suffer due to pollution—and were unwilling to return to the country if these conditions worsened. The tourists interviewed were also willing to pay considerably more for improved marine and coastal resources including wider beaches, better water quality, and greater coral and fish diversity. Another study, conducted in Southern California, showed that Orange County residents were losing millions of dollars each year because beachgoers were avoiding littered beaches in favor of cleaner beaches even though they were farther away and more costly to reach (Leggett et al. 2014). This has generated a loss in tourism revenues and additional cost for beach cleaning besides being hazardous to beachgoers and coastal waters. Another study, in Sweden, showed that marine debris on beaches reduced tourism by between one and five percent (OSPAR Commission 2009). These studies suggest that even limited amounts of marine debris can significantly lower revenues, especially for a region like the Caribbean that is so dependent on tourism.

Litter in the marine environment breaks down and interacts with wildlife. Once litter is in the marine environment, the biodegradable components degrade while the persistent materials such as plastic and Styrofoam predominate. The structure of these remaining fractions further break down. In the case of plastic, the result is small pieces (less than 5 millimeters) called micro-plastics. These have been shown to interact with marine wildlife and its impact is under active scientific investigation.

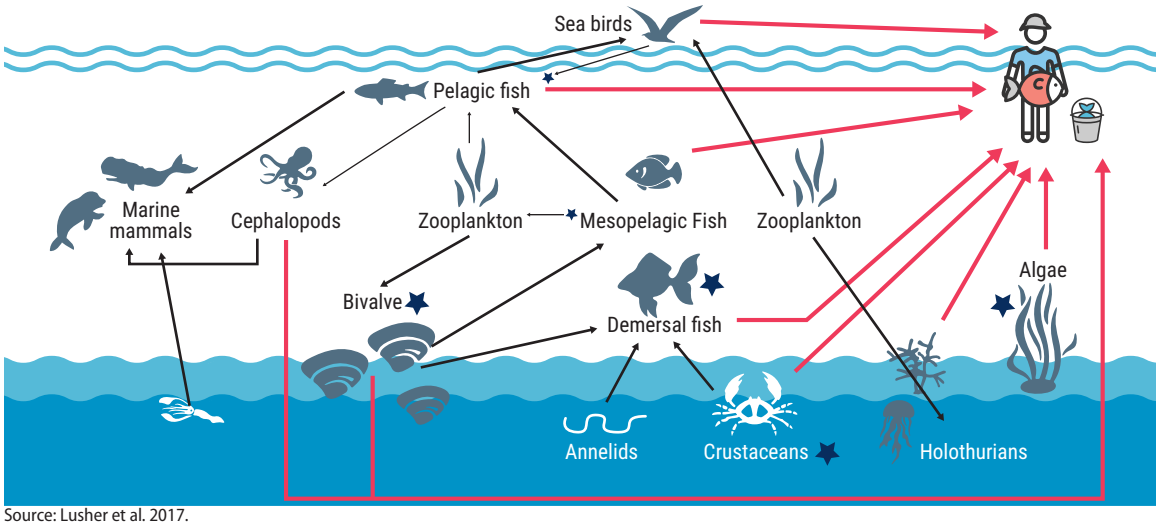
Over 600 species of wildlife have been documented entangled in or having ingested marine litter. Of these species, 15 percent are considered threatened or endangered (Lusher et al. 2017). Ingestion of microplastics has been documented in multiple species within the food chain (Boucher and Friot 2017), including in the Caribbean (UNEP-CEP 2017) (Figure 3.1.7). Documented impacts for species that are in contact with plastic include death, injury, stranding, and increased prevalence of disease. A study assessing quantities of microplastics and zooplankton in Jamaican waters found that the most abundant type of microplastics were fragments (87 percent), followed by foam (9 percent) and fibers (4 percent). Comparing abundance of microplastics to zooplankton indicated a 0.25 probability that fish would encounter a microplastic particle during feeding (UWI Mona Campus Research Days 2018). Microplastics can spend prolonged periods of time in animals, becoming embedded in the stomachs and gills (Akpan 2014). The impacts remain an active subject of scientific investigation, including possible false satiation and changes in buoyancy.

Litter can transport species beyond their natural ranges. Floating litter gives eggs and organisms such as algae, crabs, clams, and mussels the ability to travel from their native environments to new parts of the world. The potential impact on the introduction of new species to a region or expansion of the range of common species is a subject of scientific study because it can threaten ecosystems. One study conducted in 2003 found that plastic litter served as a vector for the transport of a marine species that caused harmful algal blooms in the northwest Mediterranean (Maso et al. 2003).

Plastics may concentrate pollutants in marine environments. Plastics absorb pesticides and persistent organic pollutants such as PCBs at high levels, with some studies indicating concentrations of more than 100 times those found in sediments and 1 million

11 Average annual cases of Chikungunya, non-outbreak years (2013, 2015, 2016) 6,386 reported, 138,264 total; outbreak year (2014), 820,392 reported 17,761,487 total; Dengue, non-outbreak years (2011, 2012, 2014, 2015, 2017), 23,881 reported, 358,212 total; outbreak years (2010, 2013, 2016), 103,509 reported, 1,552,630 total; and Zika non-outbreak year (2017), 7,935 reported, 45,343 total; outbreak years (late 2015-2016), 87,369 reported, 499,252 total. Statistics cover the (Spanish-, English-, and French-speaking islands of the Caribbean. Reported incidence is from www.paho.org. Estimates of totals are based on expansion factors for these diseases in the literature, Chikungunya, EF=21.65; Dengue, EF=15, and Zika, EF=5.7.

Figure 3.1.7 Interactions of Marine Biota and Microplastics and Possible Trophic Pathways



Source: Lusher et al. 2017.

Note: Black stars represent microplastic particles and black dotted arrows observed interactions between an organism and particle (direct ingestion or uptake). The black arrows indicate indirect ingestion of microplastic particles (potential trophic transfer). The red lines indicate potential routes of microplastics to humans following ingestion of seafood. Finally, arrow thickness represents potential bio-accumulation of particles through the food web.

times those occurring in seawater (Teuten et al. 2009). One analysis (Rochman and Browne 2013), found that at least 78 percent of "priority pollutants" listed by the U.S. Environmental Protection Agency (EPA) and 61 percent listed by the European Union (EU) are associated with plastic debris. This, combined with marine organisms' documented ingestion of microplastics, has raised speculation that plastics may facilitate transport and bioaccumulation of these pollutants in marine environments. In addition, additives to plastics such as Bis-phenol-a (BPAs) are being investigated as to their potential impacts in the context of marine debris.

Efforts for Litter Prevention in the Caribbean

Caribbean countries are part of a global movement to ban or tax some of the main items of marine debris. As of January 2019, 14 countries in the Caribbean Region had banned Styrofoam, plastic bags, or both (Table 3.1.4). These efforts are designed to reduce the use of common litter items. Implemented in many places in the world, they have reduced litter, improved aesthetics, and cut costs of cleanup.[12] Among the countries in the Caribbean with laws in effect are Haiti and Antigua and Barbuda, which banned Styrofoam and plastic bags in 2013 and 2016 respectively. While the program in Haiti has had limited results on the ground, the initiative in Antigua and Barbuda has shown progress.

Box 3.1.2 A Ban on Plastic Bags—the Experience of Antigua and Barbuda

In Antigua and Barbuda, 90 percent of all plastic waste was bags distributed by supermarkets. By banning Styrofoam, plastic bags, and other single-use food service items, the proportion of plastic at the landfill dropped from 19.5 percent in 2006 to 4.4 percent in 2017. The ban on plastic bags occurred in two phases—the first banned the importation of plastic shopping bags, the second banned use of the bags. An eight-step implementation process was undertaken: (1) the announcement of the ban and its two phases, (2) consultations with external and internal stakeholders, (3) additional consultations with supermarkets to resolve identified challenges, (4) Cabinet approval, (5) drafting of regulations, (6) gazetting of regulations, (7) notifications to all stakeholders that the regulations had been gazetted, and (8) final consultations with external agencies and additional awareness initiatives. This eight-step plan was critical to the success of the ban. The two phases gave stakeholders time to prepare for the eventual banning of all plastic bags while continuous dialogue improved participation and compliance (UNEP-CEP in press).

12 For example, in October 2015 England introduced a five-pence charge on single-use plastic bags. An estimated 7 billion of these bags were distributed the year before the introduction of the fee. It caused distribution to plunge to only 500 million bags in the first six months. Overall, the fee is projected to reduce distribution of single-use plastic bags by about 80 percent in supermarkets and save £60 million in clean-up costs (Smithers 2016).

Table 3.1.4 WCR Countries that Have Banned Plastic Bags and Styrofoam

Country	Materials targeted	Description	Date of implementation
Antigua and Barbuda	Plastic bags	Ban on importation and commercial use other than garbage collection Alternative products are tax- free.	January 2016: Ban on importation July 2016: Ban on use
Antigua and Barbuda	Styrofoam for food service (1st phase) Plastic utensils, Styrofoam trays, and egg cartons (2nd phase) Styrofoam coolers (3rd phase)	Ban on importation and use Applies to all businesses in the food service industry. Alternative products are tax free.	January 2017: 1st phase January 2018: 2nd phase January 2019: 3rd phase.
Aruba	Plastic bags	Bans the use of plastic bag with handles intended for single use.	January 2017
Barbados	Plastic bags	Charge (Bd$0.20 per bag) by participating retailers that sign voluntary agreement	June 2017
BVI	Plastic bags	15-cent charge on plastic bags at grocery stores that sign a voluntary agreement	March 2013
Dominica	plastic straws, plastic plates, plastic forks, plastic knives, Styrofoam cups, Styrofoam containers	Ban announced: Restrictions on imports of non-biodegradable containers for stores and restaurants that distribute them.	January 2019
Grenada	Styrofoam food containers Plastic bags	Ban on importation of Styrofoam food containers; and plastic shopping bags (single use bags), disposable plastic plates, spoons and forks.	August 2018: Ban on importation for Styrofoam February 2019: Ban on importation for single-use plastic bags, disposable plates, forks and spoons
Guyana	Styrofoam food containers	Ban on importation and use by food establishments of Styrofoam food containers	April 2016
Haiti	Plastic bags Styrofoam for food purposes	Ban on production, importation, commercialization and use of single use plastic bags and Styrofoam for food purposes	2013
Jamaica	Single use bags, plastic straws and Styrofoam	The ban covers the importation, manufacture and distribution of the materials.	January 2019
Puerto Rico	Plastic bags	Applies to commercial establishments (food service industry exempted)	December 2016
St. Lucia	Styrofoam and single use plastic including plates and cups.	Ban on importation and subsequent total ban on use.	December 1, 2018: Ban on importation.
St. Vincent and the Grenadines	Styrofoam food service products	Ban on importation, manufacture, sale, and use of Styrofoam food service products	May 2017: Ban on importation January 2018: Ban on use
Turks and Caicos	Plastic bags	Ban on the importation of plastic bags followed by a ban on its distribution.	January 2017: Ban on importation April 2017: Ban on use
USVI	Plastic bags	Requires businesses and organizations to use reusable bags or recyclable paper bags. Plastic bags are allowed where no acceptable substitute exists, such as wrapping of prepared foods or meats.	April 2017

Source: Review by authors.

Littering is being tackled by raising public awareness. Beyond the marine litter that is due to poor collection, litter in streets, tourist areas, and public spaces due to bad habits and a lack of public awareness is a common concern. Much of it eventually makes its way into waterways, coastal areas, and the marine environment. In the Caribbean, governments and NGOs are making common efforts to adjust people's behavior through campaigns of education and public awareness (Figure 3.1.8).

Table 3.1.5 Street Sweeping Coverage in Greater Santo Domingo

Municipality-District	Population (2011)	Street sweeping coverage (%)
East Santo Domingo	969,253	35
Pedro Brand	53,717	30
Nigua	34,066	50
Alcarrizos	250,333	95
National district (Ayuntamiento Distrito Nacional)	1,128,771	40
Guerra	42,572	90
North Santo Domingo	454,386	60
Bajo Haina	144,129	35
Boca Chica	122,577	30
West Santo Domingo	350,209	10
Total	3,550,013	42

Source: JICA-BID-NIPPON KOE 2011

Figure 3.1.8 Anti-Littering Campaigns in the Caribbean

Sources: Jamaica Environment Trust, Dominica Solid Waste Management Corporation, and SWMCOL-Trinidad and Tobago.

Figure 3.1.9 Cleanup Days in the Dominican Republic and St. Lucia

Street sweeping is a common means in the region of preventing litter from entering waterways but the service has limited coverage. For example, in the Dominican Republic 70 percent[13] of municipalities indicate they provide street sweeping services and within municipalities in greater Santo Domingo between 10 percent and 95 percent (a 42 percent average) of the population has this service (Table 3.1.5). In Grenada, contractors provide street sweeping in six towns with a total population of 19,251, representing 18 percent of the country's population. Quality and coverage of this service are not well regulated or monitored. National regulations and service standards do not exist in most Caribbean countries and private sector contracts for the service often have no provisions for supervision of quality.

Volunteer cleanup efforts have helped keep the environment clean. Once the litter gets into the environment, community groups often take on the challenge of clearing it away. Most activities in the Caribbean have focused on volunteer cleanup activ-

13 Regional evaluation of Urban Solid Waste Management in Latin America and the Caribbean, 2010, Inter-American Development Bank.

ities (Figure 3.1.9). However, beach cleaning services are also run by private resorts or, in the case of St. Lucia, directly by the national solid management authority (SLSWMA).

3.2 Wastewater, Sewage, and Run-off

Wastewater remains a major source of marine pollution in the WCR. On average, about 85 percent of the region's wastewater goes untreated into the ocean (GEF-CReW 2015). It comes from such sources as oil refineries, sugar factories, sewage systems, and food and beverage processing plants. These land-based sources of pollution cover multiple economic sectors—municipal, industrial, and agricultural (Box 3.2.1).

Box 3.2.1 Wastewater Covers Multiple Economic Sectors

Wastewater is used water coming from domestic, manufacturing, industrial, agricultural, and commercial sources. Domestic wastewater (often referred to as sewage) is wastewater from houses, public facilities, and businesses such as hotels and shops. Domestic wastewater can be divided into blackwater, the outflow from toilets that contains fecal materials and urine, and greywater that drains from sinks, showers, laundry machines, and dishwashers (UNEP 2000). Untreated wastewater may contain nutrients (nitrogen and phosphorus); solids (including organic matter); pathogens (bacteria, viruses, and other microbes); intestinal worms and worm-like parasites; and oils and greases. It may also contain runoff from streets, parking lots, and roofs; heavy metals (including mercury, cadmium, lead, chromium, and copper); and toxic chemicals including PCBs, PAHs, dioxins, furans, pesticides, phenols, and chlorinated organics (UNEP-CEP 2010).

Wastewater poses a significant threat to the region's development and the quality of life of its people. Wastewater's main pollution impacts occur in coastal areas and bays close to urban centers that have low levels of wastewater treatment. Pathogens in the water pose significant hazards to the health of local people and visitors. Contamination of the coastal marine environment by sewage can lead to a number of infectious diseases (diarrhea, cholera, dysentery, typhoid, and hepatitis A) being transmitted to people bathing and swimming in marine waters or eating seafood. Excess nutrients discharged into the marine environment through sewage can also cause human exposure to toxins associated with the resulting algae blooms. Moreover, sewage pollution poses serious threats to marine biodiversity, in particular coral reef ecosystems. After overfishing, high concentrations of nutrients, primarily from inadequately treated sewage, are the main cause of the widespread death of coral cover across the region (Jackson et al. 2014).

Between 1990 and 2010, the region achieved an overall reduction in the discharge of domestic pollutant loadings, despite gradual population growth. However, further analysis shows that while overall pollutant loadings in domestic wastewater have declined, notably in the southern Caribbean, in many parts of the WCR they have increased. While the overall reduction in pollutant loading is welcome, much work remains to be done to move discharge levels down in all parts of the region.

Box 3.2.2 Eutrophication

Eutrophication—the presence of excess levels of nutrients in water—creates "dead zones" and could pose the biggest single threat to the US$57 billion of revenue that the region's coastal tourism brings in annually. In order to survive, all living organisms require nutrients such as carbon, hydrogen, oxygen, nitrogen, phosphorus, and calcium. When these are in balance, healthy ecosystems are sustained. However, excess nutrients discharged into the marine environment through sewage and fertilizers from agriculture may lead to excessive growth of marine plants, known as an algal bloom. This limits the sunlight available and reduces the amount of oxygen in the water. Their hypoxic conditions may lead to coral bleaching and mortality, as well as shifts in coral abundance and distribution because some coral species are better able to tolerate these conditions (Altieri et al. 2017). This in turn affects fisheries and may be toxic to other marine life and humans. Local economies can feel pain not only from reduced fisheries but a fall-off in tourism caused by degraded reefs, contaminated beaches, and disease (UNEP-CEP 2010).

The domestic sewage contribution to marine pollution in the Wider Caribbean Region is significant. About 52 percent of households in the insular Caribbean lack sewer connections and only 17 percent have acceptable collection and treatment systems (GEF-CReW 2015). Sewage originates mostly from households, businesses, public sanitation facilities, and urban runoff.

Box 3.2.3 Wastewater Impact on Health

Polluted coastal waters annually generate an extra 120 million cases of gastroenteritis worldwide and 50 million cases of Acute Respiratory Distress (ARD), estimates show. This raises global public health expenses by about US$12 billion per year (Shuval 2003). Preliminary results from a tourism study in Barbados indicate that two thirds of visitors consulted would not return if seawater quality would cause an increase in stomach infections (Gray et al. 2015). The unregulated disposal of human waste and insufficient drainage in island countries have resulted in standing pools of contaminated water which during severe weather overflow and spread sewage-related disease (GIWA 2004).

Wastewater Treatment in the WCR

Wastewater treatment facilities are absent or insufficient in many countries of the region, in particular small islands (GIWA 2004 and Peters 2015). The types and levels of wastewater treatment used throughout the region are not well documented. But primary treatment is known to be the predominant method, with secondary or tertiary treatment less common. Primary treatment removes suspended solids and a certain amount of organic material. This at the least decreases waterway blockage and reduces health impacts while providing some environmental co-benefits such as mitigating problems of decreased oxygen availability for ecosystems. However, water that is treated at only the primary level retains the ability to do harm when large amounts of this treated wastewater are discharged into waterways leading to the ocean or directly into the marine environment. Tertiary treatment, required to maintain healthy coral reef ecosystems, is rarely used in the region. The most widely used treatment method in the region is on-site treatment, including septic tanks, soakaways, and pit latrines. In areas where soil conditions do not permit sewerage, wastewater effluent is disposed of in street drains (Gray et al. 2015).

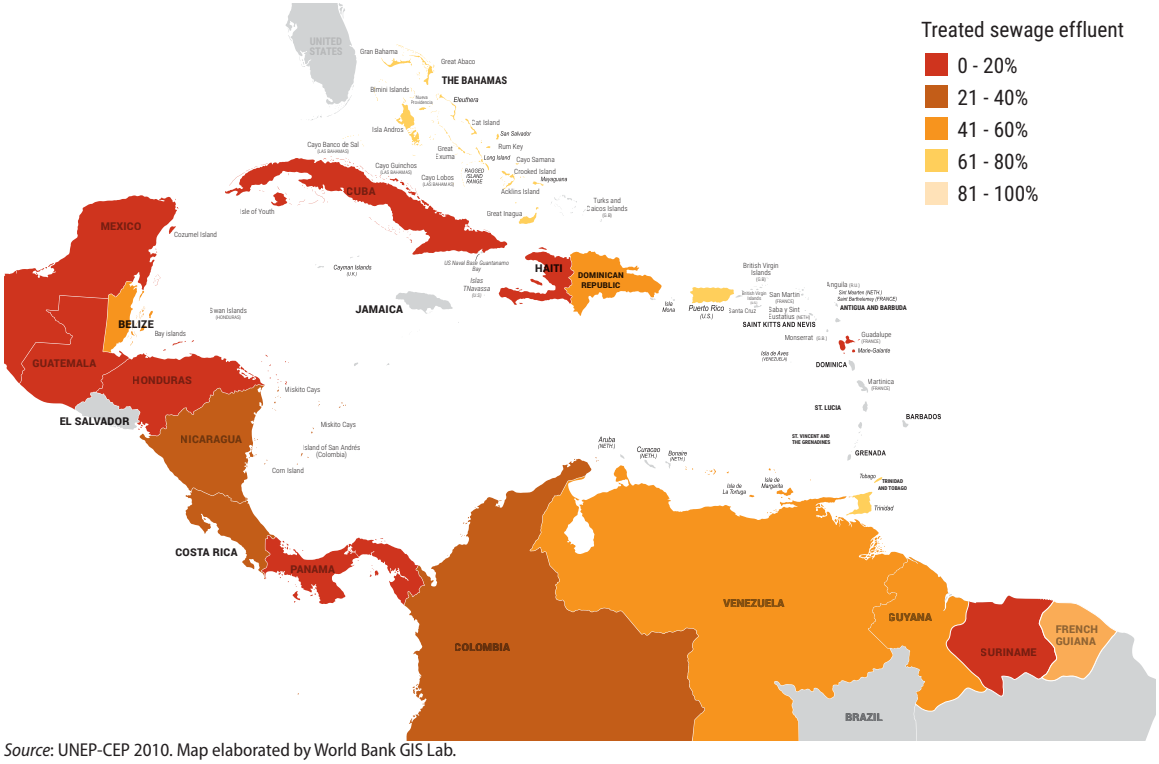
Domestic wastewater treatment rates are low for the entire region. On average, only 37 percent of the wastewater which flows into the sea in the WCR from larger countries (excluding the United States) is treated. Countries such as Colombia and Costa Rica treat approximately 35 percent of their wastewater (UNEP-CEP 2010). In island nations, these percentages are even lower. In the Eastern Caribbean, only 8 percent of it is treated (mostly with primary treatment) and less than 2 percent of urban sewage is treated before disposal (Peters 2015).

In Trinidad and Tobago, which hosts one of the largest treatment plants in the insular Caribbean, only about 30 percent of domestic sewage goes to treatment plants, while the rest is directly or indirectly discharged into surface waters. Approximately 50 percent of households use septic tanks and soak-away systems to dispose of their domestic sewage, while 27 percent have pit latrines, and only 22 percent enjoy disposal to a sewer system. Other island nations have similar shortcomings. In Barbados, only two municipal sewage treatment systems serve the country, discharging directly into the marine environment (Peters 2015). In Haiti, human waste disposal is the most urgent problem. There are no sewage collection services and only 40 percent of the population, mostly urban residents, use latrines and septic tanks. Eighty to 90 percent of the solids from these are dumped illegally into rivers and the sea (UNEP-CEP 2010).

A few countries have established submarine outfalls as alternative municipal treatment options for coastal cities, including Havana, Cuba, and Cartagena, Colombia (UNEP-CEP 2010 and World Bank 2014). Outfalls technology is often coupled with preliminary wastewater treatment that removes organic matter and suspended solids, using the assimilative capacity of the sea for further treatment. As such, siting and design of a submarine outfall through sophisticated modeling and oceanographic studies are critical to ensure that the receiving seawater has sufficient dilution capacity. However, nutrients such as nitrogen or phosphorous have not been removed from the discharged water, which is a concern in some marine environments, in particular for coral reefs. High-quality construction is required to avoid leakage in the outfall and continuous monitoring to ensure the outfall performs as planned. Under the appropriate conditions, outfalls may constitute a cost-effective wastewater treatment option. The outfall system in Cartagena generated environmental improvements within a relatively short time (World Bank 2014).

In most countries where wastewater infrastructure exists, it is outdated or below required capacity. Proper operation and maintenance of treatment plants is often lacking. For example, the Dominican Republic has 56 municipal waste treatment plants but about two thirds are not operational (Grullon 2013). While some countries have succeeded in raising

Figure 3.2.1 Domestic Wastewater Treatment Rates in the WCR



Source: UNEP-CEP 2010. Map elaborated by World Bank GIS Lab.

the number of private wastewater treatments plants, supervision by state agencies is often poor and many of the plants are dysfunctional (UNEP-CEP 2015).

Do we actually know the amounts of nutrients that reach the region's marine environment?

The region's countries do not systematically collect data on the amount of nitrogen and phosphorus that enters the marine environment from wastewater. Actual amounts will depend on the local level of treatment, quality of septic systems, environmental and climatic conditions, and other factors such as how common phosphate-reduced detergents are in local homes and businesses. Given that very few nutrient-reducing treatment systems are operating in the WCR, it is fair to expect that a high percentage of the nutrient content in wastewater will end up in the marine environment.

Both wastewater and agriculture generate high levels of nutrients. For wastes from communities where most homes and businesses have piped water, typical pollutant composition of domestic sewage are indicated in Table 3.2.1. In unsewered areas, septic tanks are common. Septage from these tanks must be removed and properly disposed of every few years to ensure effective operation of the system. Typical pollutant composition of septage taken to wastewater treatment facilities is shown in Table 3.3.2. The lesson from these estimates is that wastewater is a relatively high contributor of nitrogen and proportionally smaller contributor of phosphorous, in comparison with agricultural sources. For agriculture, studies have shown that nitrogen is the limiting nutrient for eutrophication in marine systems. For effective management, both nutrients need to be controlled.

Table 3.2.1 Composition of Domestic Sewage in the Wider Caribbean Region

Parameter	Value
Total suspended solids (TSS)	200-300 mg/ L
5-Day biochemical oxidation demand (BOD)	200-250 mg/ L
Chemical oxidation demand (COD)	350-450 mg/ L
Total nitrogen as N	25-60 mg/ L
Total phosphorus as P	5-10 mg/ L

Source: GEF-CReW 2015.

Box 3.2.4 The Tourism Industry and Wastewater

The tourism industry is a major contributor to wastewater problems, particularly concerning waste treatment and disposal. Tourists at Caribbean resorts consume at least three times as much water as local residents. On average, a hotel guest uses approximately 825 liters of water a day (EarthCheck Research Institute 2013). Hotels alone account for 10 to 15 percent of the total water supplied by municipal distribution systems. For example, in Barbados, the tourism sector consumes over 16 percent of the total water and in Jamaica more than 14 percent (Tapper et al. 2011). The high consumption at tourist facilities is linked to extensive landscaping and amenities such as swimming pools, golf courses, and water parks (Peters 2015). This increases the stress on water resources and raises the level of nutrients reaching the marine environment, affecting the quality of coastal waters and beaches. It may undermine the health of local people and tourists alike.

However, in some countries such as Barbados, hotels are required to install their own wastewater treatment plants (primary or secondary) and treated water is sometimes reused, mostly for irrigation or landscaping (Peters 2015). In at least one resort, 100 percent of wastewater is reused. Rainwater and treated wastewater are often combined for the watering of plants.

Table 3.2.2 Composition of Septage from Septic Tanks in the Wider Caribbean Region

Parameter	Value
Total suspended solids (TSS)	10,000-25,000 mg/ L
5-Day biochemical oxidation demand (BOD)	3,000-5,000 mg/ L
Chemical oxidation demand (COD)	25,000-40,000 mg/ L
Total nitrogen as N	200-700 mg/ L
Total phosphorus as P	100-300 mg/ L

Source: GEF-CReW 2015.

Wastewater is More than Domestic Sewage: The Non-Point Sources of Pollution

In addition to sewage, other important sources of wastewater pollution are watershed and waterway runoff through "non-point sources," that is, contaminated water that enters the environment over a wide geographical area rather than at a discrete point. As such, integrated coastal zone management (ICZM) is critical for the region, in particular in the insular Caribbean where the "coastal zone" often constitutes the entire island. Coastal zones in larger countries cannot be managed as isolated entities either. They are the end point of a number of river basins, so Integrated River Basin Management is also an important tool. South American rivers such as the Magdalena and Orinoco discharge large quantities of freshwater directly into the Caribbean Sea while others, notably the Amazon, put it into currents that flow into the Caribbean. According to the World's Water Quality Assessment, approximately one quarter of all stretches of river in Latin America and the Caribbean can be classified as severely polluted. An estimated 25 million rural people in the region come into contact with polluted waters, creating serious implications for environmental health (UNEP 2016).

Run-off from agricultural non-point sources, including fertilizers and pesticides, is a significant concern in the region. Colombia and Costa Rica use significantly higher levels of fertilizer per hectare of cultivated land than most countries in the world, at 578.6 and 490.6 kilograms per hectare respectively (World Bank 2014). These rates are due in great part to the two countries' extensive monocultures of commercial crops for export. Monoculture fields typically attract high volumes of pests, which in turn causes farmers to apply high amounts of pesticides. Agricultural best practices allow for alternative techniques that can decrease the volumes of fertilizer (PNUMA-UCR/CAR-REPCAR 2011). Other countries in the region, meanwhile, make only moderate use of fertilizers, such as Jamaica (79.9 kilograms per hectare) and Mexico (61.7 kilograms).

Increased sedimentation has adversely impacted the biodiversity in the WCR region. Most of the rivers in the region discharge sediment loads ranging between 100 and 1,000 milligrams per liter (UNEP 2001), resulting in more than 1,000 million tons deposited in coastal waters annually[14] (UNEP-CEP 2010). The preva-

14 For comparative purposes, average global estimate of annual sediment load to the world's oceans varies from 15 to 30 x 103 tons/year, of which rivers in Asia and the large Pacific Islands (such as Papua, Borneo, and Sumatra.) contribute about 70 percent (Milliman and Meade 1983). In comparison, the Wider Caribbean Region's annual sediment loads are estimated at approximately 12 percent of global sediment input from rivers (UNEP 2006).

Figure 3.2.2 River Discharges into Mona Dam Reservoir in Kingston, Jamaica

Photo by Matthew Khoury.

Figure 3.2.3 A River on the Meso-American Coast Discharges Sediment and Nutrient-Laden Water into the Caribbean Sea

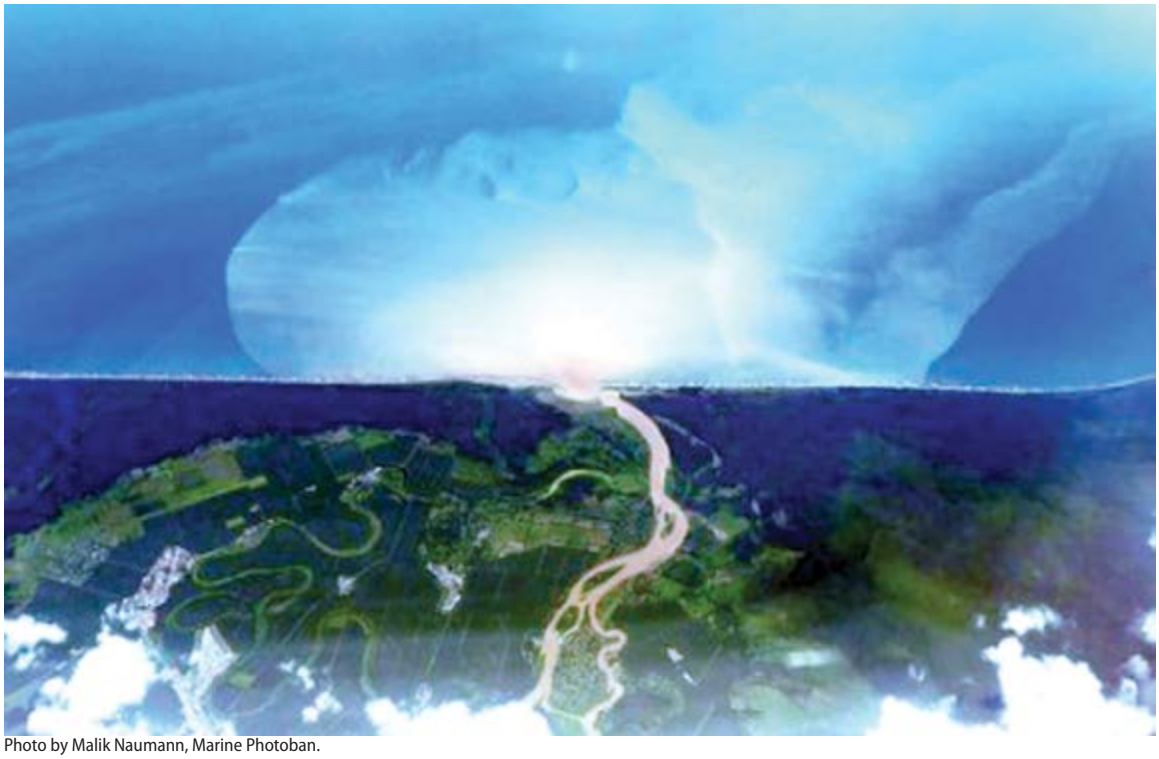


Photo by Malik Naumann, Marine Photoban.
Source: GEF-CReW 2015.

lence of suspended sediments has decreased biodiversity, severely degrading shallow coastal waters (UNEP 2000) (Figure 3.2.2). Increased sedimentation and turbidity has damaged coral reefs by reducing penetration of light that is needed for photosynthesis. Other harmful effects include sand and other sediments scouring coral, increased mortality of juvenile coral due to loss of suitable area to grow, and the direct smothering of coral (UNEP 2001 and Jackson et al. 2012).

Sediment loads to the WCR from the Meso-American region (Belize, Guatemala, Honduras, and part of Mexico's Yucatan Peninsula) amount to about 374 million tons per year (Figure 3.2.3). More than 80 percent of these loads and more than 50 percent of nitrogen loads originate from watersheds in northern Honduras, notably the Ulua River basin. A relatively lower percentage of sediment loading comes from Belizean watersheds (UNEP-CEP 2010). Land-based activities contributing to sedimentation and erosion include agriculture, forestry, urbanization, and mining.

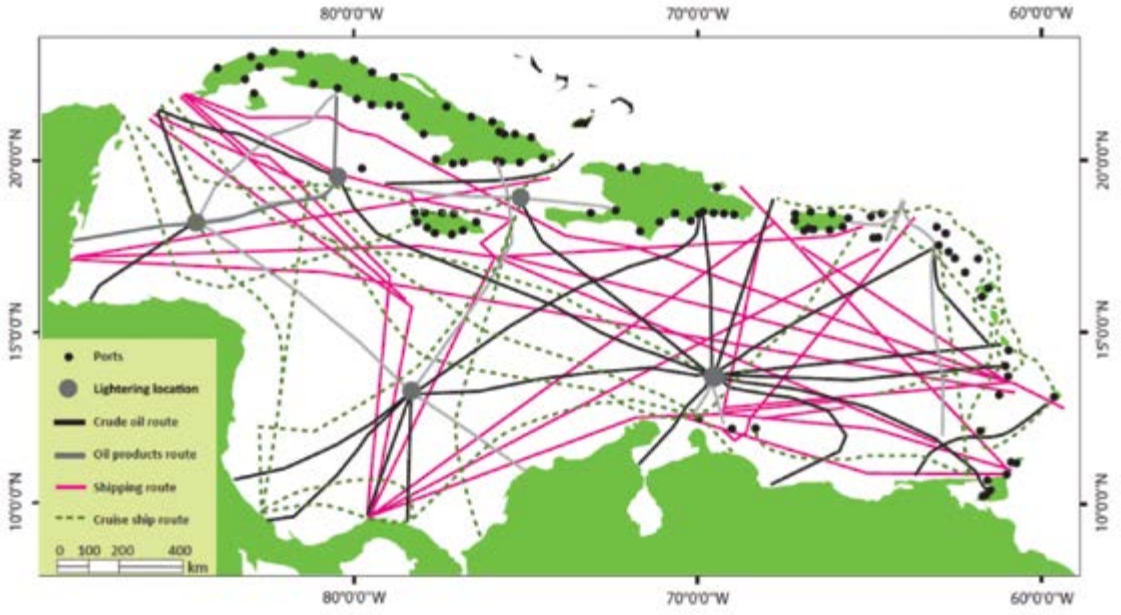
At an average 250,000 cubic meters per second, the Amazon River is the largest contributor of freshwater to the WCR. The plume of the Amazon is enormous, extending hundreds of kilometers northwest into the Caribbean Sea. Another major river, the Orinoco River, is the second-largest source of suspended solids in the region, with more than 100 million tons annually and 248 million tons of nitrogen as a result of the intensive use of fertilizers and agrochemicals by farmers in its watershed (UNEP-CEP 2010).

3.3 Pollution from Ships

Shipping is the most energy-efficient and common way to move large volumes of cargo. Ships carry two-thirds of all traded goods, amounting to 9.35 billion tons of cargo crossing the world's seas in 2013 (Werschkun et al. 2014). In 2012, 8.2 percent of global container shipping volume passed through the region due to the presence of the Panama Canal. Shipping is a major segment of the ocean economy in the Caribbean, representing 76.4 percent of it[15] (Patil et al. 2016).

With an average of five million barrels of crude oil moving daily through the WCR and 70 million tons passing annually through the Panama Canal, estimates show that about 250 major and minor oil spills will occur each year in the Caribbean Sea and the Gulf of Mexico[16]. Modeling by Singh et al. (2015) concluded that approximately 83 percent of the Caribbean Sea was at risk from oil

Figure 3.3.1 Shipping Routes in the WCR



Source: Singh et al. 2015.

15 Note: this percentage should not be compared with the GDP of the Caribbean Basin countries, since not all of this economic value accrues to those economies.
16 http://www.acs-aec.org/index.php?q=es/node/5972

spills due to shipping. Findings like these underline the need for a management framework for minimizing ship-generated oil pollution in the Caribbean Sea. Among the recommended components of such a framework are a common policy, surveillance and monitoring controls, standards, monitoring programs, data collection, and greater rates of convention ratification.

Box 3.3.1 Maritime traffic in the WCR is on the rise.

The Panama Canal was recently expanded to receive ships carrying 13,000 containers instead of the 5,000 standard container vessels previously accepted (www.micanaldepanama.com/expansion). There are also plans to build a 280-kilometer canal through Nicaragua to accommodate even larger megaships and help reduce heavy traffic and delays at the Panama Canal. However, this project could destroy almost 400,000 hectares of tropical forests and wetlands, home to threatened and endangered wildlife and indigenous communities (Wan et al. 2016).

The WCR is one of the world's busiest destinations for the cruise ship industry, with a 34 percent share of the global market in 2013. In 2016, the Caribbean received approximately 26.4 million people through cruise ship visits, an increase of almost 30 percent from 2010. Some countries recorded much larger increases (CTO 2016). For instance, in St. Kitts and Nevis, tourist arrivals from cruise ships increased almost 300 percent. In the Dominican Republic the rise was almost 130 percent, and in Jamaica, about 80 percent.

Expanding cruise ship tourism in the Wider Caribbean comes with a high environmental cost. On a one-week voyage, a middle-sized cruise ship (about 3,500 passengers) generates 795,000 liters of sewage, 3.8 million liters of grey water, 500 liters of hazardous waste, 95,000 liters of oily bilge water, and eight tons of garbage (Wan et al. 2016).

The region's small ports have limited facilities for handling waste and sewage from cruise ships and holiday-makers who disembark. Most countries in the region, in particular, island nations, lack adequate port reception facilities, according to IMO/UNEP-CEP (IMO 2016). Belize is a dramatic example. Visitors increased from 58,131 in 2000 to 800,000 in 2004 and more than a million in 2016 (CTO 2016), yet it does not have in place the infrastructure to accommodate the liquid and solid wastes generated by these guests (www.gefcrew.org). Ships often rely on clean harbours free of debris in order to navigate safely. Ports that do not maintain clear and clean waterways suffer from loss of business (UNEP-CEP 2014).

The shipping industry is another important source of marine litter. This is more than small waste items that crew members may throw overboard. Due to accidents and other unforeseen circumstances, cargo ships sometimes lose all or part of their cargo at sea. Estimates based on a survey carried out between 2008 and 2013 indicated that on average about 1,700 containers are lost at sea globally each year due to accidents. That translates into 14 out of every million containers transported going overboard, on average (UNEP 2016).

Antifouling paints used on vessels are also a concern, considering the growing number of recreational boats in the region (UNEP 2006). Antifouling paints, containing heavy metals and toxic chemicals such copper or tributyltin (TBT), discourage the growth of life on submersed hulls. The International Convention on the Control of Harmful Antifouling Systems on Ships (the AFS Convention), prohibiting the use of organotins on ships and offshore platforms, entered into force internationally in 2008. Although the convention does not explicitly ban TBT-based paints, relevant industries are urged to refrain from selling them and, in many member states, laws prohibit their retail sale. However, despite the well-documented harmful effects of TBT on marine life, TBT-based paints are still being manufactured in the United States and apparently offered for sale through outlets in the Caribbean and Central America (Turner and Glegg 2014).

Primarily through their ballast water, ships are today the leading vector by which larvae and marine organisms such as juvenile shellfish, micro-organisms, bacteria, and viruses spread over long distances, becoming invasive species if they find a suitable receiving environment. According to the IMO, it is estimated that, globally, between 7,000 and 10,000 different species (including microbes) are transferred *each day* in ballast waters (Globallast Partnerships). In 2013, an estimated 3.1 billion tons of ballast water was discharged in oceans worldwide (Werschkun et al. 2014). Species arriving in this water can do major damage if they compete with local species for space or nutrients. They can be toxic both to humans and marine life and harm local fisheries. For example, cholera epidemics have been traced to ballast water discharges. While *Vibrio cholerae* and other

Figure 3.3.2 Distribution in 2013 of Invasive Lionfish in the WCR

Source: Gomez Lozano et al. 2013.

pathogens do occur naturally in coastal waters, they are normally not in high enough concentrations to cause human health problems. The introduction of invasive aquatic species is virtually irreversible and has been identified as one of the four greatest threats to the world's oceans (GESAMP 2001).

Ballast water can also carry toxic microalgae that result in harmful algal blooms, known as "red tides." These algae accumulate in shellfish such as oysters, mussels, and scallops, making them toxic to humans. The result can be outbreaks of seafood poisoning, including paralytic shellfish poisoning, which can cause severe illness and even death in humans.

The lionfish is an important example of how a marine invader can disrupt ecosystems and economies in the WCR. A voracious and indiscriminate feeder native to the Pacific and Indian Oceans, the lionfish has no major predators in Caribbean waters. These attributes allowed it to proliferate rapidly in recent years and colonize the entirety of coastal waters in the WCR (Figure 3.3.2) . The newcomer caused an alarming reduction of reef fish populations and disrupted the balance of Caribbean reef ecosystems. The decline of several commercially important fish species, including some that are a major source of protein for coastal communities, has been attributed to the lionfish invasion (Gomez Lozano et al. 2013). Though no one is certain how the lionfish arrived, many experts believe that the brightly colored fish were brought to the region as aquarium curiosities and somehow entered its waters.

Box 3.4.1 Releases Associated with Petroleum Consumption

Releases associated with petroleum consumption make up 70 percent of the petroleum introduced to the world's oceans from man-made sources. In North America this proportion rises to 85 percent. Major sources include urban runoff, petroleum refinery wastewater, municipal wastewater, and non-refining industrial wastes. As the population of coastal regions increase, urban runoff has become more polluted due to rise in the numbers of cars, asphalt-covered highways and parking lots, municipal wastewater, and the use and improper disposal of petroleum products. These releases occur almost exclusively as slow chronic releases (NRC 2003).

The WCR is a major source of crude oil, producing an average of 12.7 million barrels per day in 2011, about 18.1 percent of the world total (UNDP 2012). Major oil producers in the WCR are the United States, Venezuela, Mexico, Colombia, and Trinidad and Tobago. The WCR has 51 tanker terminals (Figure 3.4.1). A significant amount of the produced oil goes by ship to the United States through an intricate network of routes (UNEP-CEP 2010). As such, the region faces a serious threat of oil spills in accidents and technological failures as crude oil is produced and tankers move it.

Box 3.4.2 Oil Spills in the Region

The region has endured three of the 10 largest oil spills in history, a reminder of the scope of this industrial threat to the region. The most recent was the Deepwater Horizon disaster of 2010 in the Gulf of Mexico, in which 210 million gallons of oil spewed out over three months. It became the largest accidental marine oil spill in the history of the petroleum industry. The other two spills both occurred in 1979—the Ixtoc 1 Oil Well (140 million gallons), also in the Gulf of Mexico, and the collision of two supertankers off the coast of Tobago (88.3 million gallons), the largest ship-based oil spill in history. By comparison, the Exxon Valdez spill ten years later released only 9.77 million gallons (Telegraph 2011).

3.4 Industrial Pollution – Oil, Heavy Metals, Toxic Chemicals

Industrial activities in the WCR such as oil refining, food processing, chemical manufacturing, and mining are potential threats both to marine resources and human health. Sources of discharge of industrial waste are hard to quantify because, with a few exceptions, industries in the region are not required to report them. But the general level of industrial activity can be used to determine areas of concern.

- Oil refineries are high in BOD5 and COD, dissolved salts, odor, phenol, and sulfur compounds.
- Food processing industries, distilleries, and soft drink plants are very high in BOD5 and COD, suspended solids, dissolved solids, variable pH, and organic matter.
- Chemical industries account for 1 percent of the WCR's BOD load, which is frequently toxic to aquatic organisms at very low concentrations. Pesticides and insecticides used for agriculture are the primary chemical wastes in the Caribbean, high in organic matter and toxic to bacteria and fish.

Ninety percent of hydrocarbon pollution in the WCR's marine environment originates from land-based industrial sources and activities, according to estimates by UNEP-CEP. These sources include oil refineries, which number over 100, with 75 percent of them located along the Gulf of Mexico (UNEP-CEP 2010). Also contributing is oil in storm water runoff from other types of industrial sites, fuel storage facilities, and roads (Jones 2011).

Satellites have helped the Wider Caribbean achieve near-real-time monitoring of oil discharge into the sea. In 2010, the MODIS sensor on NASA's Terra/Aqua satellites provided a unique twice-daily perspective of the extent and movement of the oil slick originating from the Deepwater Horizon oil platform. Satellites have also been useful for monitoring smaller day-to-day leaks and discharges of oil from ships and production facilities (Onoda and Young 2017).

Globally, releases of oil from offshore production make up only three percent of total petroleum discharges into the marine environment (NRC 2003). In that three percent, major spills are relatively

Figure 3.4.1 Tanker Terminals: Refineries, Offshore Installations, Navigational Hazards, Oil Terminal and Chemical Plants in the WCR

Source: UNEP/CEP.

unimportant. The most common sources of production discharges are routine exploration and production activities. These include the release of drilling fluids during exploration and well development, spills of fuel on platforms and support vessels, and spills occurring during the transfer of crude to shuttle tankers.

"Produced water"—water separated from crude oil extracted from sub-sea formations—is another form of pollution that is routinely discharged. Once treated to remove visible hydrocarbons, the produced water is either re-injected back into the oil-bearing formation or discharged into the sea. In addition to dissolved hydrocarbons, produced water may contain residues of chemicals used to stimulate production in the formation, such as dispersants, anti-corrosives, and biocides. The concentration of petroleum within produced water depends largely on the type and efficiency of the water treatment technology employed on the platform. When the water is discharged into the sea, "plumes" form, which can drift long distances with tides and winds. These may cause concentrations of hydrocarbons in filtering organisms such as oysters up to 20 kilometers from the offshore platform.

Toxic substances that are generated as by-products of industrial processes and discharged into the environment are of major concern. Heavy metals are major parts of agrochemicals, industrial pollutants that commonly show up in sewage. There is now considerable evidence in the scientific literature that contaminates such as trace metals, phosphorous, pesticides, PCBs, and polycyclic aromatic hydrocarbons can be taken up and concentrated by sediments and suspended matter in aquatic systems.

Marine sediments are the ultimate reservoir for heavy metals in the coastal environments. Contamination of estuarine sediments by trace elements is a worldwide problem. According to UNEP (2006), coastal areas near oil installations have significant heavy metal concentrations in sediments. Along the coasts of Santo Domingo, Dominican Republic, and Havana Bay, Cuba, which both have petrochemical complexes near the water, lead values have risen to 113 mg/kg and 340 mg/kg, respectively (GEF/UNDP/UNEP 1998).

Studies examining heavy metal pollution in reefs have received minimal attention worldwide, particularly in the Caribbean region. Concerted attention is needed, because coastal regions across Central America are exposed to a wide range of metal pollution. While many Caribbean countries have no major industries, around the Gulf of Mexico there are industrial hotspots discharging substantial pollutant loads into the marine environment and these find their way to the waters of other countries. The smallest industri-

al pollutant loads come from the western Caribbean (the Central American countries), while in the eastern Caribbean, Trinidad and Tobago provides the largest contribution of organic matter of industrial origin to the marine environment, a result of increased industrial development there, notably oil facilities (UNEP-CEP 2010).

3.5 Marine Pollution and Climate Change

The economies of the Caribbean have suffered severely due to the increase in intensity and frequency of extreme weather events. Wind damage alone adds about US$1.4 billion to average annual loss. Climate change exacerbates many other driving forces and therefore amplifies environmental and related socio-economic impacts (UNEP 2016). The 2017 hurricane season included four major storms in Categories 4 and 5, the most destructive, land-falling climatic events of the past few years combined. Countries along their path from the Eastern Caribbean to the Gulf of Mexico sustained damage and loss of life. The islands of Barbuda, Dominica, Saint Martin, and Puerto Rico were devastated, with recovery taking months if not years. According to an IMF study in 2016, more than 200 major storms have struck the Caribbean in the last 40 years, costing more than 12,000 lives and $20 billion in damage, with increased force and frequency, as well as a lengthened hurricane season.

Extreme weather events will compound the impacts of marine pollution and will weaken the resilience of some marine species. Increased pollution, for example, may make coral reefs more vulnerable to climate change effects (Veron et al. 2009) such as sea temperature increase and ocean acidification, which are both slow onset events that compromise the health of reefs. They can also harm biodiversity by reducing vulnerable fish species' spawning aggregation and the carbonate that shellfish such as crabs and lobsters need to build their shells. As corals and other marine species struggle to live in warmer and acidified waters around natural carbon dioxide seeps, they also face the compounded problem of pollution. The pollution increases their susceptibility to diseases and morbidity. When coral reef die-off occurs, it in turn hampers carbon fixation in the oceans, reducing their ability to effectively capture carbon dioxide—i.e. carbon sequestration. These stresses on the marine ecosystem can ultimately threaten livelihood security for people who depend on it (Allen and Webber 2013). But urgent actions to diminish pollution's impacts on marine ecosystems will result in environmental co-benefits, including better climate resilience for ecosystems and increased carbon sequestration (IEG 2017).

Figure 3.5.1 Beach Covered with Large Amounts of Seaweed in Cancun, Mexico

Photo Credit: Israel Leal/AP Photo.

Pollution can also turn non-harmful naturally occurring species into potent threats to local economies. In recent years, especially in 2018, beaches in countries from Mexico to the Eastern Caribbean islands were hit by a massive wash-up of Sargassum seaweed (CAST 2015, and UNEA 2016) (Figure 3.5.1). Warm water temperatures and low wind anomalies helped cause this event, but it was also linked to increased nitrogen loading from sewage pollution, oils, and fertilizers (CAST 2015). Although the appearance of Sargassum is a recurrent phenomenon that is generally not harmful to humans, in this case it damaged fisheries by causing mass fish deaths. In St. Kitts and Nevis, one human death was indirectly attributed to Sargassum when a fishing boat crew was washed overboard after a seaweed entanglement disabled their engine (UNEA 2016). The seaweed harmed tourism by limiting access to beaches where masses of dead seaweed piled up, emitting foul odours and sometimes trapping litter such as plastics and hazardous waste. There was also a potential rise in vector-borne diseases. The economic cost mounted as swimming, boating, and watersports were disrupted and local hotels received numerous cancellations, hurting the livelihoods of people in the tourism industry (Hinds et al. 2016).

Coastal ecosystems are an effective line of defence against climate events, slowing down storm surges and reducing flooding. According to UNEP (2010), the degradation of coastal ecosystems has increased storm surge risk in Negril, Jamaica. A one-in-50-year hurricane has the potential to produce storm waves of almost seven meters, affecting about 2,500 Negril residents, more than 60 hotels and their guests, and water and sanitation infrastructure. Poor water quality hinders coastal ecosystems' capacity to grow and recover following storms or severe temperature events (Nellemann and Corcoran 2006). For instance, sediment deposited onto reefs smothers corals or blocks out sunlight they need to grow and hampers their ability to reproduce. Similarly, pesticides interfere with coral reproduction and growth (NOAA 2017). Therefore, by impeding natural recovery of marine ecosystems, water pollution can affect the overall resilience of coastal communities in the Caribbean.

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CHAPTER 4

Marine Pollution Policy Frameworks

Global and regional policy frameworks that address marine pollution are comprehensive in scope and target its major sources. These instruments outline obligations and commitments by governments, and, in some instances, offer a blueprint for an integrated, multisectoral response to marine pollution. National policies should be aligned with these global and regional frameworks to effectively meet international commitments and fully benefit from international cooperation and funding from donors and partners.

The first UN Conference on the Human Environment in 1972 set the world on a path toward a great number of initiatives and agreements recognizing the interdependency of humankind and the natural environment, including the marine environment. As the concept of sustainable development and its three pillars—economic, social, and environmental—were adopted by the international community, so were key environmental agreements reflecting those principles. These include Agenda 21, the Rio Declaration, and the Conventions on Climate Change, Biological Diversity, and Desertification.

The last twenty years have seen a tremendous upsurge in environmental awareness, which culminated with the adoption in 2015 of the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs). The SDGs are far-reaching, all-encompassing targets for 2030, creating a blueprint on how to mobilize efforts towards ending all forms of poverty, fighting inequalities, and tackling climate change, while ensuring that no one is left behind.

The SDGs build on the work of the earlier Millennium Development Goals and are unique in their broader scope to eradicate all forms of poverty. They call for action by all countries, rich and poor, to promote prosperity while protecting the planet. SDG 14 on oceans specifically addresses marine pollution but, given the integrated nature of the SDGs, several other goals are also relevant to control of marine pollution (Figure 4.1.1).

The SDGs provide countries of the Caribbean with an opportunity to realign and strengthen their national efforts to achieve economic prosperity in a more inclusive manner while respecting the capacity of the natural environment. This process will facilitate mainstreaming of environmental considerations into the economic and social dimensions of development.

Caribbean nations' ability to realize the benefits of the Blue Economy will depend on managing

Figure 4.1.1 Marine and Coastal Pollution within the Context of the 17 SDGs

marine resources and activities sustainably within the framework of international law. This framework comprises a complex network of international and regional agreements, intergovernmental and civil society organisations, and economic market-based drivers. The most relevant are briefly discussed below. These and others are detailed in Annex 1. The status of ratification of relevant international conventions can be found in Annex 7.

4.1 International Frameworks and Initiatives of Relevance to Marine Pollution Management in the WCR

UN Law of the Sea Convention

The basic international framework governing use and development of the oceans is provided by the 1982 United Nations Convention on the Law of the Sea (UNCLOS). The convention defines the extent of various jurisdictional zones, delineated according to distance from the coastlines on the basis of set baselines, and sets out the rights and obligations of countries on the basis of those zones. Countries have sovereignty over their internal waters, territorial seas, and archipelagic waters, and sovereign rights over the resources in their Exclusive Economic Zones and the seafloor of their continental shelves.

Parties have agreed to take, individually or jointly as appropriate, all measures consistent with UNCLOS that are necessary to prevent, reduce, and control pollution of the marine environment from any source. As this concerns the marine environment in its entirety, parties have the obligation to protect and preserve the marine environment in their territorial seas, their exclusive economic zones, and areas beyond their national jurisdiction.

Parties are to adopt laws, regulations, and measures that are no less effective than international rules, standards, and recommended practices and procedures. The most significant of these rules, standards, practices, and procedures include those agreed on through the Cartagena Convention, the UN Environment Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-Based Activities, and the International Maritime Organization (IMO).

International Maritime Organization and Ship-Sourced Pollution

Shipping is one of the most heavily regulated of all marine activities. Over the years, the International Maritime Organization (IMO) has adopted and revised a broad range of instruments that respond directly or indirectly to the range of threats posed by international shipping. IMO environmental treaties almost exclusively regulate pollution by applying standards for discharge and construction, design, equipment, and manning (CDEM), irrespective of whether a discharge occurs due to an accident or the normal operation of the ship (IMO 2016). The main treaties that govern the prevention of pollution are MARPOL 73/78, the International Convention on the Control of Harmful Anti-Fouling Systems on Ships, and the International Convention for the Control and Management of Ships' Ballast Water and Sediment.

MARPOL 73/78 contains six annexes concerned with preventing marine pollution from ships.

- Annex I/II: Oil/noxious liquid substances carried in bulk (entered into force in April 1987)
- Annex III: Harmful substances carried in packaged form (July 1992)
- Annex IV: Sewage (September 2003)
- Annex V: Garbage (December 1988)
- Annex VI: Air pollution (May 2005)

A state that becomes party to MARPOL must accept Annexes I and II (hence they are listed together), while Annexes III-VI are voluntary. Annex V is particularly important, because it prohibits ocean dumping of all plastics from ships and regulates the dumping of other garbage. This annex also requires that ports must provide reception facilities.

"Special Areas" are designated by MARPOL Annex V as locations where, due to the site's unique oceanographic, ecological, or traffic conditions, all overboard discharges of garbage (except ground-up food wastes) are prohibited. The Wider Caribbean Region (including the Gulf of Mexico) was designated a Special Area under Annex V in 2011. However, the lack of port reception facilities has been a significant barrier to implementation of the Special Area and remains an issue throughout the WCR.

The UN Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-Based Activities

Adopted in 1995 by more than 100 countries and administered by UN Environment (UNEP), the GPA addresses the impacts of land-based activities on coastal and marine environments. It is designed to assist states in taking actions individually or jointly within their respective policies, priorities, and resources which will lead to the prevention, reduction, control, and/or elimination of the degradation of the marine environment. Litter is one of the nine source categories identified by the GPA. This has helped spur many regional and global actions against this pollution source.

In 2015, the GPA and the Secretariat to the Cartagena Convention based in Kingston, Jamaica partnered with the Gulf and Caribbean Fisheries Institute (GCFI) to implement the Caribbean Node of the Global Partnership on Marine Litter (GPML). The goal of the node is to achieve the objectives of the GPML and the Regional Action Plan on Marine Litter (RAPMaLi 2014), which was endorsed by the Contracting Parties to the Cartagena Convention. The Action Plan[17] updates the 2008 regional plan and describes the road ahead for reducing marine plastic debris and microplastics and other solid waste pollution.

SIDS Accelerated Modalities of Action (S.A.M.O.A) Pathway

The SIDS Accelerated Modalities of Action (S.A.M.O.A) Pathway is an international framework that was developed as the outcome of the Third International Conference on Small Island Developing States (SIDS Conference) held on 1-4 September 2014 in Apia, Samoa. This partnership framework calls for measures to manage waste, and promote sustainable development of SIDS ocean-based economies for fisheries and aquaculture, coastal tourism, seabed resources, and renewable energy. Article 58 focuses on addressing marine pollution by developing effective partnerships, including through the development and implementation of relevant arrangements, instruments, and through the sharing and implementation of best practices.

4.2 Regional and Sub-Regional Frameworks and Initiatives

In parallel with the adoption of global environmental agreements, the WCR has seen a rise in the last three decades in the number of regional initiatives. Today more than 30 regional and sub-regional organizations with some level of engagement in governance of the ocean and its resources operate in the region and support these arrangements (Mahon et al. 2013). Numerous national plans aiming to respond to these commitments and to emerging marine environmental issues have also resulted.

Caribbean Environment Programme and the Cartagena Convention

The Caribbean Environment Programme (CEP) is one of 18 UN Environment-administered Regional Seas Programmes. The CEP and its Caribbean Action Plan (1981) were established by governments of the WCR to develop regional cooperation and national action for the sustainable management and use of the coastal and marine environment. The Action Plan led to the 1983 adoption of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention). This is the most comprehensive umbrella environmental agreement for the region and provides the operative legal framework for much of the ocean governance activity in the wider Caribbean. All nations within the WCR are members of the CEP and all (except two) are Contracting Parties to the Cartagena Convention.

The Cartagena Convention covers the combined EEZs of its Parties and remains the only regional environmental treaty covering the entire WCR. It requires Parties to adopt measures aimed at preventing and controlling marine pollution, as well as to take appropriate measures to protect and preserve fragile ecosystems. To this end, the convention is supplemented by three protocols which are critical to address land-based and oil-spill pollution, as well as to conserve and manage critical habitats and species that constitute the basis for the region's natural capital:

17 The full text can be found at http://www.cep.unep.org/cep-documents/rapmali_web.pdf

- The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region (Oil Spill Protocol)
- The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region (SPAW Protocol)
- The Protocol Concerning Pollution from Land-Based Sources and Activities (LBS Protocol)

The convention provides support for the implementation of sub-regional, regional, and global initiatives involving the countries of the Wider Caribbean. These include the Saint Georges Declaration for the OECS, the Caribbean Sea Commission, the Sustainable Development Goals, and several multilateral environmental agreements.

Caribbean Sea Commission

The Association of Caribbean States (ACS) and its partners have been pursuing the Caribbean Sea Initiative since 1998 mainly through promotion of the UN General Assembly Resolution "Towards the Sustainable Development of the Caribbean Sea for Present and Future Generations." It was first adopted in 1999 and subsequently reported upon, revised, and readopted (Resolution 65.155).[18] In the process, the Caribbean Sea Commission (CSC) was established in 2008 to promote and oversee the sustainable use of the Caribbean Sea and potentially provide a regional harmonization of ocean governance policy and a coordination function for the wider Caribbean region. The CSC has adopted the Large Marine Ecosystem (LME) governance framework as its working model for regional ocean governance arrangements.

The Strategic Action Program and the Caribbean Large Marine Ecosystem Project

The Caribbean Large Marine Ecosystem and Adjacent Regions (CLME+) is a large-scale Global Environment Facility project running from 2015 to 2020. Its objective is to improve the management and governance of shared living marine resources through an ecosystem-based management approach in places in the region: the Caribbean and North Brazil Shelf Large Marine Ecosystems(http://www.clmeproject.org/). The CLME+ project builds on and complements existing projects and initiatives that emphasize technical and institutional aspects of sustainable use of living marine resources (LMR) by focusing on governance, knowledge, and institutional issues in a transboundary marine context. The Strategic Action Program endorsed by 25 governments participating in the CLME+ provides a roadmap towards improved governance of the region's main marine ecosystems and guides the long-term agenda.

Revised Treaty of Chaguaramas and Caribbean Community Common Fisheries Policy

The 2001 Revised Treaty of Chaguaramas established the Caribbean Community (CARICOM), including the Common Market and Single Economy Organisation. CARICOM promotes development of policies for the protection of the environment, efficient management, and sustainable use of natural resources, and sustainable development. Subsidiary bodies relevant to the control of marine pollution include the Caribbean Public Health Agency (CARPHA), the Caribbean Disaster Emergency Management Agency (CDEMA), the Caribbean Regional Fisheries Mechanism (CRFM), and the Caribbean Community Climate Change Centre (CCCCC). In ensuring "the prudent and rational management of the resources of Member States," the treaty recognizes both the "precautionary" and the "polluter pays" principles. It also recognizes principles related to preventative action, rectification of environmental damage at source, and the need to protect the region from harmful effects of hazardous materials transported, generated, disposed of, or shipped through or within the Caribbean community.

CARICOM's Draft Environment and Natural Resources Policy Framework articulates a regional approach to the sustainable management of the environmental and natural resources of member states. It reflects an awareness that unsustainable use of resources could undermine regional sustainable development options within the context of the 2030 SDGs. It proposes a structure for balancing the need to exploit land, air, water, and oceans for economic development with the maintenance of healthy environments. As an

18 In the resolution, the UN General Assembly "Recognises that the Caribbean Sea is an area of unique biodiversity and a highly fragile ecosystem that requires relevant regional and international development partners to work together to develop and implement regional initiatives to promote the sustainable conservation and management of coastal and marine resources, including, inter alia, the consideration of the concept of the Caribbean Sea as a special area in the context of sustainable development, including its designation as such without prejudice to relevant international law."

umbrella policy framework, it provides the guiding principles for planning the protection, conservation, and sustainable use of the environmental and natural resources of the CARICOM member states.

In addition to these policy agreements, there are important regional and sub-regional programs that provide environmental policy guidance and promote better practices for the marine environment. A number of these have resulted in concrete, region-wide multi-partner projects that respond to specific marine pollution issues in the WCR.

- **GEF Caribbean Regional Oceanscape Project (CROP).** Approved by the World Bank in 2017, CROP will support five eastern Caribbean countries in strengthening capacity for ocean governance through the development of coastal and marine spatial plans (including identification of pollution hotspot sites); enhancement and/or creation of national ocean policies; and development of capacity-building tools for enhanced ocean governance, including a learning platform on the blue economy. This project aims to assist the eastern Caribbean countries in their transition towards a Blue Economy and implement Blue Economy policies to leverage public and private investment in the waters of the OECS region.

- **GEF Caribbean Regional Fund for Wastewater Management (CReW).** It began in 2011 as an initiative to provide sustainable financing for wastewater management, support policy and legislative reforms, and facilitate regional dialogue and knowledge exchange. It is implemented by the Inter-American Development Bank (IDB) and UNEP-CEP (www.gefcrew.org).

- **The 2014 Regional Action Plan for Marine Litter (RAPMaLi) for the Wider Caribbean Region.** Originally established in 2007, RAPMaLi promotes collaboration and engagement of a wide range of actors in actions to improve the management of marine litter on local and regional scales (UNEP-CEP 2014). The network includes health, environmental, conservation, education, tourism, and waste management bodies (www.cep.unep.org).

- **The GEF project Integrating Water, Land, and Ecosystems Management in Caribbean Small Island Developing States (IWEco).** This supports an integrated approach to water, land, and ecosystems services management through policy, institutional, and legislative reforms. It also helps implementation of appropriate technologies to accelerate access to safe water and improved sanitation, while contributing to improved ecosystem functioning in the Caribbean (http://www.cep.unep.org/gef-iweco-1/gef-iweco).

- **Caribbean Biodiversity Fund Ecosystem-based Adaptation (EbA) Facility.** The EbA Facility is a sinking fund, initially financed through the German Development Bank (KfW) to €25 Million. The Facility will award grants for the period 2018 to 2022 for actions in Overseas Development Assistance (ODA) qualified insular Caribbean countries to support climate change adaptation and poverty alleviation through biodiversity conservation and ecosystems management within their marine and coastal zones. The grants will assist efforts to maintain and increase resilience of ecosystems (including through the impacts of land-based sources of marine pollution) and people in the face of the adverse effects of climate change.

4.3 Implementation Challenges

While initiatives, agreements, and regulations applicable to marine pollution in the WCR are extensive, their implementation is often hampered. A lack of political will is a major factor which can have far-reaching repercussions. They can include inaction, fragmented or poorly designed legal and institutional frameworks, structures that do not meet the guidelines of international and regional agreements, and compliance and enforcement at the national level. Without strong political will, effective implementation and enforcement of strategies, legislation, and international agreements will not be possible. This will also lead to poor governance of the marine environment and coordination among the Caribbean states.

Limited financial resources and technical capacity can impede success in marine pollution programs that are costly and highly technical. These limitations may result in insufficient institutional capacity and human resources for construction and management of essential infrastructure for sewage treatment, and waste reduction, collection, and disposal. They may also contribute to weak or lack of country-level pollution-monitoring systems. Limited institutional capacity among service providers and difficulties in recovering costs also hamper implementation. For these reasons, the identification of critical resources, and the funds to provide them, is crucial.

CHAPTER 5

The Way Forward

The environmental, social, and economic impacts of marine pollution in the Caribbean have been well documented over the last three decades and expose a very serious threat to the sustainable development of the region. The ability of governments to effectively and sustainably manage the region's natural resource base will determine the future of the countries' economies and their success in combating poverty and reversing socio-economic inequalities. The well-being of the growing population of the region requires that these issues and trends be addressed urgently. There is no time to waste!

This study establishes some important conclusions about marine pollution in the Caribbean.

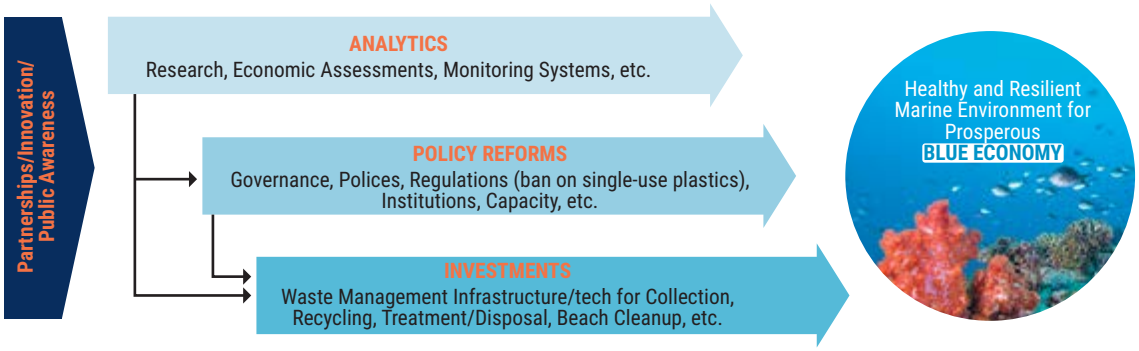
- Marine pollution has been growing at alarming rates in the WCR. Caribbean SIDS are especially vulnerable to the impacts of pollution as it leads to reduced revenues from the tourism and fishing industries that these countries depend on.
- Marine pollution pays no respect to national borders—pollutants generated in one country can find their way to the waters of another. Caribbean SIDS are exposed to concentrations of marine litter that are disproportionate to their own consumption and population.
- Marine pollution damage goes beyond marine ecosystems and biodiversity. It is already affecting human health and major economic activities in the region such as tourism, fisheries, and shipping.
- The destruction of marine ecosystems such as coral reefs, mangroves, and seagrass beds pose particular threats to the livelihoods of people working in tourism and fisheries and to protection from storms and hurricanes.
- Solid waste and wastewater pollution, among the most pervasive types of land-based marine pollution in the region, are projected to grow as populations, coastal cities, and tourism do the same.
- Solid waste and wastewater cause serious environmental harm in the ocean ranging from litter to eutrophication and algal blooms. These in turn drive tourism revenues down and increase exposure to infectious diseases.
- While knowledge of marine pollution issues has expanded, the region still lacks rigorous assessment and understanding of sources and impacts but in the absence of knowledge and certainty countries should not wait to act. In such cases the "Precautionary Approach" is justified and uncertainties must be factored into the risk assessment and cost-benefit analysis.
- The costs of inaction will likely be greater than those of pollution prevention and management, given the economic impact on sectors such as tourism and fisheries.
- Considerable progress has been made at the global and regional levels to establish policy frameworks and commitments to tackle marine pollution. But cross-border cooperation, resources, and a comprehensive and integrated approach—all needed to decisively take on the challenge—remain in short supply.
- Blue Economy policy priorities should be incorporated into national and regional development planning to ensure that the marine natural capital is sustained and enhanced while the ocean economy continues to grow.

5.1 Recommendations

While marine pollution is an urgent problem to tackle in the Wider Caribbean Region, the recommendations of this report target Caribbean SIDS. Caribbean SIDS are particularly exposed and vulnerable to the present and future damage from marine pollution, which leads to reduced revenues from the tourism and fishing industries that these countries depend on. Additional unique challenges for these countries include small land mass, vulnerability to extreme weather events, poorly developed waste management infrastructure, and majority of their populations living within 10 kilometres of the ocean.

The World Bank proposes a 12-point action agenda for responding to pollution problems facing Caribbean SIDS, and taking specific forward looking and concrete steps in support of a healthy, productive, and resilient Caribbean Sea. A proposed way forward incorporates preventative and responsive approaches through a combination of analytical activities, policy reforms for enhancing the enabling environment, strategic investments, public awareness, partnerships and innovation. The framework for action involves four broad groups of activities that are needed to effectively find solutions for marine pollution (Figure 5.1.1). The scale of these activities ranges from the local to national to regional. These are aligned with relevant international and regional mandates, and if adopted would significantly contribute to the region's pathway toward the Blue Economy.

Figure 5.1.1 Framework for Action to Address Marine Pollution



1 Improve the analytics and knowledge base on marine pollution and water quality throughout the region using common monitoring approaches and guidelines.

The Caribbean has a paucity of quality-assured environmental data about its waters, because only a few countries have the necessary systems in place to collect them. Policy decisions need to be based on solid scientific information. Otherwise, the Precautionary Approach principle must apply. Therefore, regular collection of strategic data on pollutants and how pollution affects marine habitats, local economies, and populations needs to be improved at the regional and national levels. Monitoring approaches should now include microplastics, as plastics are the most common items found littering the beaches.

Monitoring efforts should be integrated into relevant regional assessments and reporting efforts, particularly those established under the Cartagena Convention and its Protocols (SOCAR report) and the report on the State of the Marine Ecosystems and Associated Economies (SOMEE) of the CLME+ SAP, which calls for information on habitat degradation, fisheries status, and marine pollution. Monitoring should include earth observation through partnerships with satellite operators. Pollution control metrics should be integrated into SDG matrices and other monitoring platforms to promote sectoral integration.

Systematic and strategic monitoring should be strengthened or established to quantify the sources, flows, fate and extent of industrial, agricultural and municipal wastes and effluents. It is particularly important to understand key pollutants that enter water bodies, identify pollution hotspots, and their impacts on marine biodiversity, fisheries, and human health. Information should be integrated into regional reporting processes to enhance regional cooperation.

Indicators to measure progress in achieving outcomes and outputs should be established and incorporated within monitoring strategies. Results from monitoring should be used as appropriate to mitigate risk constraints to achieving improved waste management and pollution control.

2 Step up assessment of the economic impacts of marine pollution, and quantify the costs associated with pollution prevention and management, as well as the costs associated with doing nothing.

The economic impacts of marine pollution (particularly solid waste and waste water) need to be better understood to help prioritize and plan regional and national programs, as well as to determine the costs associated with improper waste management and marine pollution. Costs of waste management activities, special clean-ups, and maintenance of beach and coastal areas should be assessed and integrated within pollution prevention and control measures. It should also examine revenues lost by the tourism (e.g. costs associated with the loss of recreational uses of coastal areas) and fisheries (e.g. costs for lost or abandoned fishing gear) sectors when pollution causes visitors to stay away and harms fisheries. Health impacts should also be assessed to inform the policy-makers and the public about the needs for effective management. Analytical work to support strategic and cost-effective multi-country solutions at identified hotspots will also be useful.

The impacts of marine pollution on a country's economy should provide the impetus needed to ensure that regional and national waste management programs and policy reforms are prioritized. These could include best practices and reforms to improve waste management and operations at disposal sites, the implementation of disincentives for the use of polluting substances, and incentives for the use of reusable, recyclable, or compostable packaging and development of industry standards on what materials are put into the marketplace.

Economic impacts of marine pollution should be included in, or complement, national and regional assessments and reports on marine pollution or on the status of marine ecosystems. Establishing common standards for measuring existing or potential economic losses would facilitate data collection and provide solid data sets on which to base decisions. This information should lead the necessary policy reforms to cover a wide range of measures, including potential for incentive and fiscal mechanisms (taxes, bans on single-use plastics, etc), minimization of waste generation, improvement of final waste disposal, extended producer responsibilities, among others.

3 Strengthen and harmonize existing national institutional structures, policies, and legislation to effectively reinforce regional governance and align with international mandates and commitments.

Policies and legislation should be aligned with international commitments for sustainable development such as the SDGs and relevant MEAs, including those specific to marine pollution such as elements of the regional LBS Protocol. Governance of the marine environment and coordination between SIDS in the region remain fragmented, with poor integration of environmental considerations into regional development planning and a lack of integrated management of the marine environment. Many regional and international policy frameworks related to pollution already exist but often legal and institutional frameworks to address pollution are weak, fragmented, and ineffective, and do not meet the minimum guidelines of international agreements which the country has signed. For example, specific marine litter regulation is very limited, and even when it exists, there is often poor implementation, compliance, and enforcement at the national level. What is needed is forthright implementation of them to yield harmonized governance that addresses transboundary pollution in an integrated way. Active participation and support of all relevant governments and organizations in these regional programs and initiatives will help the Caribbean meet its commitments to address marine pollution.

The Cartagena Convention's LBS Protocol is a key instrument for addressing land-based pollution in the WCR and should be ratified by governments which have not yet done so. Other relevant MEAs and initiatives such as Cartagena's Oil Spill and Biodiversity Protocols, the MARPOL 73/78 Convention, and the CLME+ SAP are also key mechanisms towards improved marine pollution control and environmental management. Governments should increase efforts to actively implement their mandates.

In addition, existing national institutional structures, policies, and legislation for marine pollution management should be strategically reviewed, harmonized, and/or updated to accommodate international obligations, including the above agreements, and new challenges. Increased and concerted efforts can help ensure implementation, compliance, and enforcement.

4 Integrate marine pollution prevention and control policies into the broader context of national policy and planning frameworks.

Marine pollution is not an isolated environmental issue. It affects the economy, health, and general wellbeing of the population. Cost-effective tools such as Marine Spatial Planning and Integrated Coastal Zone Management to help manage multi-use coastal areas, and River Basin Management designed to protect natural water systems, need wide implementation. The value of critical coastal ecosystems (such as mangroves and wetlands) in the natural treatment of pollution and coastal protection should be recognised in coastal planning decisions.

Marine pollution prevention and control must receive high priority and be integrated within national and local broader planning processes. Pollution control is relevant not just to coastal and marine resources but also to the development of tourism, agriculture, shipping, and industry. As such it should be part of economic and land-use planning, as well as integrated water/catchment management.

5 Heighten local expertise and technical capacity concerning pollution and water quality management.

A key challenge facing SIDS in the region is insufficient human capacity required for effective governance, management, and production structures. Many of the solutions to pollution problems are highly technical, requiring sophisticated technology, laboratory analysis, and operation of advanced equipment. Solving this problem will take time, capital, and changes in the region's educational system to offer the necessary training. But it will be well worth the investment, allowing the region to take on pollution with its own world-class expertise.

The capacities and knowledge to tackle marine pollution need to be built evenly across the public and the private sector as well as amongst consumers. From the private production perspective, for example, the right knowledge and capacity to find economically viable alternatives to polluting packaging and materials will be of relevance. Capacities amongst the public sector, government, and consumers to incentivize such practices will be equally important. Enhancing consumers' knowledge and capacity to make better decisions regarding their day to day waste production will greatly contribute towards the solution.

While building technical capacity takes time, in the meantime, SIDS governments need to devise ways to leverage greater output from current capacity to foster positive change. Increased regional cooperation, sharing of costs and knowledge, and public/private partnerships will help narrow this gap. Along the value chain of locally available products, actors and stakeholders, both public and private, can greatly benefit from specified guidelines and training on minimizing their waste footprint.

6 Raise public awareness about the importance of water quality and marine ecosystems to induce behavioural change.

There is limited awareness of the relationship between development and environmental protection among citizens of Caribbean countries, as well as between ecosystem health and the production of ecosystem services. Changes in perception about the importance of coastal ecosystems is imperative to change how individuals relate to the environment and cause, at all levels, and induce positive behavioural changes with respect to littering, improper solid waste disposal, and reduction and recycling of waste. Public education and awareness campaigns targeting school and communities play an important role in minimizing the impact of marine pollution, as well as targeting specific user groups (e.g. fishermen). Higher public awareness would help prioritize the issue in national and local political agendas, facilitating larger budgets, commitment, stricter legislation, and enforcement at large. This will also require improved communication techniques between technical specialists, stakeholders, and the public at large. The broad participation of stakeholders will give them a sense of empowerment against the threat of marine pollution.

Public education on local television, radio, social media, and websites can raise awareness on the value of ecosystems services. These tools should also be used to promote and facilitate enforcement of waste management practices and regulations. But the environment's importance to the region's welfare needs to be taught in the classrooms as well. This would entail involving ministries of education to introduce new material into school curricula so that children in upcoming generations will grow up with a grasp of the issue.

7 Strengthen multi-sectoral mechanisms and establish partnerships to address marine pollution.

However comprehensive regulatory frameworks are, they are likely to fail without the participation and cooperation of the many parties that have an interest in the effective management of the marine environment. These include civil society, the tourism and fisheries industries, coastal developers, technology companies, institutions and coastal communities. The design and implementation of an integrated pollution prevention and management framework should therefore include mechanisms to consider the views and interests of users of the marine space

and resources, both in national policy making and deliberations at the regional level. Multi-sectoral and inter-agency mechanisms already established under regional and international agreements and initiatives (e.g. the Cartagena Convention) should be utilized to enhance coordination, maximize resources, and assist with transboundary pollution control at the source.

Public-private partnerships should also be established to provide financing, improve public awareness, reduce the improper disposal of waste and develop innovative approaches to reduce marine pollution. The private sector is in a unique position to provide leadership in the design, development, and implementation of clean, non-polluting, sustainable practices and technologies for pollution control.

Active participation of key stakeholders in pollution management should be encouraged, and the mechanisms established to facilitate their involvement should be utilized and strengthened. SIDS should capitalise on national, regional and international platforms to develop strategic and cooperative marine pollution assessment and control measures.

Partnerships with the private sector can facilitate enforcement, create incentives for cleaner consumption and production, and incentivize transition to a more sustainable, circular economy. Promotion of EPR (extended producer responsibility) should also be explored, including legislation reforms to address the recovery and recycling obligations of individual producers.

8 Prioritize, dedicate, and increase funding within national budgets for marine pollution prevention and control.

Many SIDS countries in the region lack funds to build essential infrastructure for management of pollution, such as sewage treatment plants and disposal facilities. Issues of money also hamper monitoring and pollution abatement activities. Moreover, pollution programs are often funded out of general budgets, rather than dedicated sources. These essential programs need higher budgets, from sources that will not be at risk of running out year-to-year.

Options for funding pollution programs range from charging fees for ecosystem services, applying the "polluter pays" principle, and introducing market-based incentives, tax incentives and reforms. These might include subsidies for pollution control, permit systems for "green" businesses with pollution, deposit-refund systems, and pricing approaches.

9 Make a strategic investment commitment to litter control.

Litter is one of the main marine pollution problems in the region. To tackle the multiple sources, causes, and actors involved, regional bodies and local and national governments need to take the lead and attack the problem in a strategic way. Policy makers need to better identify hotspots and understand the volumes of, and reasons for, litter and to develop action plans to control it. These should include:

-*Planning Controls:* Introduction of urban and tourism planning that would prevent litter-generating activities from having easy access to coastal waterways and drainage systems. These can include the use of natural drainage systems and urban design to prevent direct littering into drainage systems and waterways.

-*Source Controls:* Measures to avoid the generation of litter through better education and enforcement; improved collection; greater coverage and efficiency of sweeping and cleaning services; better enforcement of waste management in tourism and key commercial and industrial sectors; and enacting bans on common litter items such as single-use plastic bags, Styrofoam containers, and plastic straws.

-*Downstream Controls:* Programs and infrastructure to intercept or clean up litter once it is produced and enters drainage or natural water systems. These include designing drainage systems to facilitate interception of waste;

better maintenance of drainage systems; beach and harbor cleanup services; and community-led programs for clean-ups.

Island or city-level integrated litter management strategies and action plans should be developed to provide understanding and commitment, and to implement practical and cost-effective litter control. Action plans should include a suite of controls that balance priority and cost-effectiveness measures with measurable short and long-term impacts. Better data and information sharing on marine litter should be championed at the regional level.

10 Make a decisive commitment to reduce consumption of common and persistent litter items including plastics.

Plastics constitute a main component of litter in the region and this is impacting key economic activities such as tourism and fisheries. Countries of the region and world have adopted a number of strategies to address this issue cost-effectively within a multi-phase approach. Controlling these litter sources should be considered a national priority or as part of island-wide or local litter management strategies, and implemented in a well thought-out and deliberate manner to avoid further environmental degradation. Interventions to consider include:

- Fees, voluntary programs, and bans on import and use of common litter items that are persistent in the environment such as single-use plastics (bottles, straws, plastic bags, cups, and cutlery) and single-use Styrofoam food containers. Such programs should include:
  - A phased approach
  - Incentives for alternatives (tax incentives and other)
  - Targeted awareness and outreach program to sensitize stakeholders about the issue, build consensus and facilitate enforcement
  - Adequate enforcement and monitoring
- Work to limit the production and use of plastic in non-recoverable items, such as microbeads in personal care products and cosmetics.
- Partner with the manufacturers and retailers to reduce other types of packaging that are common and persistent litter items. Encourage reduction of use of non-biodegradable products or packaging as well as reuse of items.

Priority action on common and persistent litter items including single-use plastics and Styrofoam is necessary and a realistic goal for countries in the region. It can be accomplished with a well-planned, phased approach without major financial investment, but with substantial gains. The economic and environmental benefits will be far-reaching in terms of tourism product enhancement, prevention of diseases, protection of biodiversity and fisheries, and savings on coastal clean-ups and waste collection and management.

11 Implement integrated, high-priority interventions to reduce discharge of untreated sewage and nutrients, and promote resource recovery of waste water.

Though most countries in the region have enacted legislation, policies, and action plans on wastewater management, implementation is often weak and piecemeal. The situation merits strong national and regional interventions, with a thorough assessment of institutional responsibilities, cost recovery, and policies to map the scale of the problem and define remedial actions. It is key to transition from ad-hoc and isolated waste water solutions ("one treatment plant per municipality") to an integrated river basin planning approach that incorporates the climate variable.

Integrated Urban Water Management (IUWM) is a flexible, participatory, and iterative process that integrates the water cycle with urban development and river basin management to maximize economic, social, and environmental benefits. It allows for phased approaches to meeting water quality standards, basin-level (rather than national) water quality standards, and incentives for resource recovery. For large and growing cities, IUWM strategies that move from linear approaches to a circular economy are recommended. Wastewater interventions to consider include:

- Increase treatment, recycling, and reuse of wastewater by at least 50 percent by 2030. Connect all households to the sewerage system, eliminate sewer overflows, and reduce stormwater-related pollution. Treated wastewater should be seen as a resource which, if used wisely and safely to avoid health problems, can be very beneficial in particular in small islands where fresh water resources are scarce.
- Explore partnerships to tap into practical and innovative technological solutions. Submarine outfalls, combined with preliminary treatment, may be an appropriate solution. But they must be accompanied by extensive environmental, engineering, and social studies for protecting the marine environment.
- Enhance coordination on wastewater management within national plans. Update legislation to reflect modern realities. Address weaknesses in enforcement caused by insufficient human capacity, surveillance, and compliance with standards.
- Plan and design infrastructure commensurate with proper technical capacities, financial mechanisms (including public and private resources), and institutional frameworks. Make long-term sustainability the guiding principle.

The region needs an intergovernmental task force to coordinate sustainable wastewater management (including a focus on nutrients) and to protect the region's coastal and marine environment. The task force should include governmental and civil society representatives from national bodies. It should work within or coordinate with the existing intergovernmental processes, including the UNEP-CEP/LBS Protocol, the CLME+, CARICOM and could utilise the Caribbean Platform for Nutrient Management.

The region should conduct a detailed assessment of current and future treatment levels and gaps; financial flows; prioritization of investments (including technology and financially sustainable options); and the existing institutional, regulatory, legal, and policy frameworks (barriers and opportunities). This would map the scale of the problem and define remedial actions that are holistic and integrate the water cycle with urban development and river basin management.

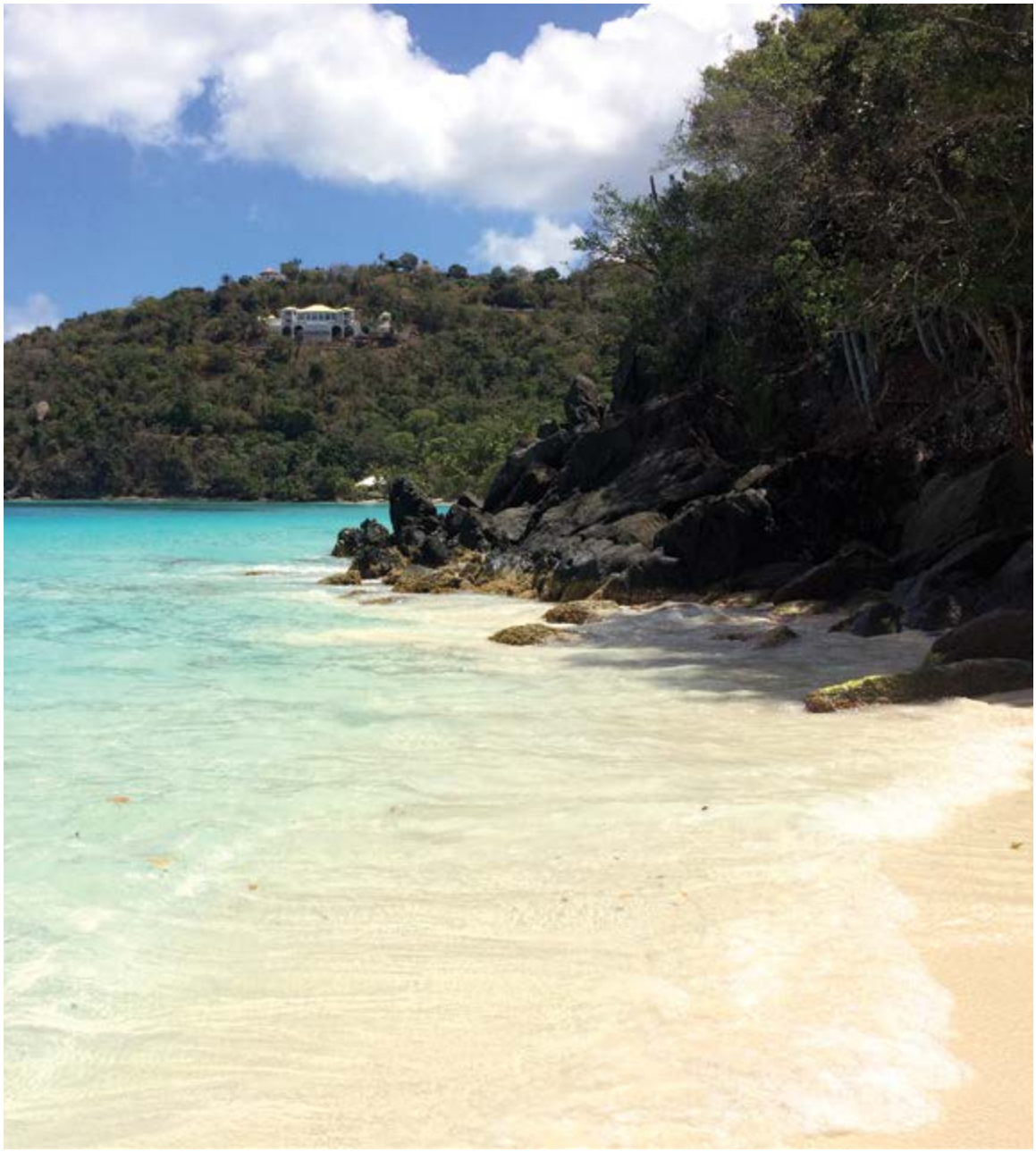
12 Improve chemical and industrial pollution control through targeted and cost-effective measures in priority issues.

The continued growth of the region will place added pressure on the region's existing wastewater and stormwater networks. In densely populated urban areas, these problems are exacerbated by the additional pressures of further increases in impervious area and greater contaminant loads. There are no simple solutions to reducing the quantity of discharges, or improving the quality of discharges on a regional basis. However, while comprehensive data on industrial pollution sources and impacts in the region are lacking, key issues common to several countries have been identified which could benefit from targeted interventions:

- Identify and characterize pollution/chemicals-related hotspots (such as highly industrialised areas and "high risk" industrial sites) in order to develop strategies to minimise pollutant loads entering the marine environment.
- Compile available information on pollution prevention and waste minimization methods for regional industries.
- Reduce and mitigate risks associated with natural resources extractive industries, including controlling the use and release of chemicals in industrial, small-scale, and artisanal mining.

- Promote recycling of used oil in urban areas through technical assistance and feasibility studies.
- Incentivize transition to a circular economy in industries to minimize generation of pollution by recycling and reuse, with a view to achieve more efficient and cost-effective systems where all non-renewable materials used are recycled. Incentivize production of durable products that require lower quantities of materials and less energy to manufacture and generate less waste.

A coordinated approach is required to target the highest polluting industrial activities and areas within the region. A key aspect of such an approach needs to be engagement with the industries to implement better practices for the storage and handling of pollutants and the treatment and management of discharges from industrial sites. Coupled with this is a need to better educate local communities about the need to dispose of hazardous substances more effectively.



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Annexes

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Annex 1: Summary Table on Marine Pollution Conventions

Agreement	Protocol(s)	Adopted (A) / Entered Into Force (E)	Summary
The Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention)		24 March 1983 (A) / 11 October 1986 (E)	The Convention and its three Protocols constitute a legal commitment by the participating governments to protect, develop, and manage their common waters individually and jointly. The Convention is a framework agreement setting out the political and legal foundations for actions to be developed nationally and regionally and in response to the specific protocols of the Convention.
	Protocol Concerning Specially Protected Areas and Wildlife	18 January 1990 (A) / 18 June 2000 (E)	The SPAW Protocol to the Cartagena Convention has been internationally recognized as the most comprehensive treaty of its kind. The objective of the Protocol is to support biodiversity conservation through protection of fragile ecosystems and habitats; threatened and endangered species; and those species requiring management, to prevent them from becoming threatened or endangered.
	Protocol Concerning Pollution from Land-Based Sources and Activities (LBS)	6 October 1999 (A) / 13 August 2010 (E)	The LBS Protocol of the Cartagena Convention aims to prevent, reduce, and control pollution and to ensure sound environmental management. It provides clear measures, effluent limits, and timetables for the reduction and control of domestic wastewater. Other important land-based pollutants are listed under different categories. Requirements for assessment and monitoring are an important component, as well as public participation in the review of possible benefits and risks of any major project likely to have an important impact on the marine environment.
	Protocol Concerning Cooperation in Combating Oil Spills	24 March 1983 (A) / 11 October 1986 (E)	This Protocol of the Cartagena Convention establishes a mechanism to respond to oil spill or threats of discharges that could endanger the marine environment and coastal interests of the countries. It requires Parties to establish and maintain the means of responding to oil spill incidents by the preparation of contingency plans and the identification and development of the capability to respond to spills. It also outlines an oil reporting procedure and calls for cooperation and mutual assistance. The Parties to the Convention extended the Oil Spill Protocol to include hazardous or toxic substances by means of an Annex.
United Nations Convention on the Law of the Sea (UNCLOS)		10 December 1982 (A) / 16 November 1994 (E)	UNCLOS is the most comprehensive global agreement governing the management of the oceans. It also creates an obligation among Parties to protect and preserve the marine environment, including to prevent, reduce, and control pollution of the marine environment from any source, in their territorial seas, their exclusive economic zones, and in areas beyond national jurisdiction. Parties are to adopt laws, regulations, and measures that are no less effective than international rules, standards, and recommended practices and procedures. The most significant of these rules, standards, practices, and procedures relevant to land-based sources of pollution in the WCR include those agreed through the Cartagena Convention, UNEP's Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities, and the International Maritime Organization.

Agreement	Protocol(s)	Adopted (A) / Entered Into Force (E)	Summary
The United Nations Global Programme of Action (GPA) for the Protection of the Marine Environment		3 November 1995 (A)	The GPA is an international non-legally binding agreement that addresses the impacts of land-based sources and activities on coastal and marine environments and human well-being. Its goal is to prevent the degradation of the marine environment from land-based activities. It is designed to assist States in taking actions individually, or jointly, within their respective policies, priorities, and resources, which will lead to the prevention, reduction, control, and/or elimination of the degradation of the marine environment, as well as to its recovery from the impacts of land-based activities.
International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78)		2 November 1973 (A) / 2 October 1983 (E)	MARPOL is the main international convention governing the prevention of marine pollution from ships by operational or accidental causes. The Convention contains six annexes, concerned with preventing different forms of marine pollution from ships: Annex I/II - Oil/noxious liquid substances carried in bulk (entered into force in April 1987) Annex III - Harmful substances carried in packaged form (July 1992) Annex IV - Sewage (September 2003) Annex V - Garbage (December 1988) Annex VI - Air pollution (May 2005)
International Convention on Oil Pollution Preparedness, Response, and Cooperation		30 November 1990 (A) / 13 May 1995 (E)	Its aim is to provide a global framework for international cooperation and mutual assistance in combating major oil spills. Parties are required to take all appropriate measures to prepare for and respond to oil pollution incidents, including reporting and arrangements for requesting assistance, national contingency planning, and training for relevant personnel. As required under the Convention, the IMO has developed a comprehensive training program in the field of oil pollution preparedness and response. The Convention also concerns ships, offshore units, ports, and oil terminals that are under the jurisdiction of the Party or flying its flag. They are required to have an oil pollution emergency plan.
	The Protocol on Preparedness Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS Protocol)	15 March 2000 (A) / 14 June 2007 (E)	The Protocol ensures that ships carrying hazardous and noxious substances are also covered by preparedness response regimes.
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)		29 December 1972 (A) / 30 August 1975 (E)	Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent marine pollution by the dumping of waste and other matter.

Agreement	Protocol(s)	Adopted (A) / Entered Into Force (E)	Summary
	London Protocol	17 November 1996 (A) / 24 March 2006 (E)	This Protocol was introduced to modernize and eventually replace the London Convention. Under the Protocol, all dumping is prohibited except for those waste products listed under the "reverse list" which includes dredged material, sewage sludge, fish wastes, vessels and platforms, inert inorganic geological material, organic material of natural origin, bulky items primarily comprising iron, steel, and concrete, and carbon dioxide streams from carbon dioxide capture processes for sequestration.
Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention)		22 March 1989 (A) / 5 May 1992 (E)	Its objective is to protect human health and the environment by minimizing hazardous waste production whenever possible. This means addressing the issue through an "integrated life-cycle approach," which involves strong controls, from the generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery, and final disposal. Some non-hazardous, land-based marine litter also falls under the scope of the Convention under the categories of wastes requiring special consideration.
	Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal	10 December 1999 (A)	The Protocol was developed in response to developing countries' concerns regarding their inability to cope with illegal dumping or accidental spills. The objective of the Protocol is to provide for a comprehensive regime for liability and adequate and prompt compensation for damage caused by the transboundary movement of hazardous waste.
	Bali Declaration on Waste Management for Human Health and Livelihood	June 2008 (A)	This Declaration reaffirms the commitment of Parties to the Basel Convention and other States to the principles and purposes of the Basel Convention, including the fundamental objective to protect, by strict control, human health and the environment against adverse effects resulting from the generation, transboundary movement, and management of hazardous wastes and other wastes.
Convention on Wetlands of International Importance (Ramsar Convention)		2 February 1971 (A) / 21 December 1975 (E)	The Convention provides measures for the conservation and wise use of wetlands and their international listing for protection. Parties shall take measures to preserve the ecological character of any wetland in its territory and included in the list and report if it is changed or is likely to change as the result of technological developments, pollution, or other human interference.
Vienna Convention for the Protection of the Ozone Layer		22 March 1985 (A) / 22 September 1988 (E)	This Convention seeks to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer.
	Montreal Protocol	16 September 1987 (A) / 1 January 1989 (E)	The Montreal Protocol was designed to reduce the production, consumption, and abundance of ozone-depleting substances in the atmosphere. The protection of the ozone layer would result in reduced production, import, and export of ozone-depleting substances.

Agreement	Protocol(s)	Adopted (A) / Entered Into Force (E)	Summary
	Kigali Amendment to the Montreal Protocol (not yet in force)	15 October 2016 (A)	This agreement commits Parties to cut the production and consumption of hydrofluorocarbons by more than 80 percent from 2019-2047 and thereafter. If implemented, the Kigali Amendment will help reduce pollutants, prevent millions of premature deaths from air pollution, and improve environmental quality. The agreement will further enhance processes for control of greenhouse gases under the Paris Agreement, the UN Framework Convention on Climate Change, and its Kyoto Protocol
The International Code of Conduct on Pesticide Management		Adopted in 2013	This is the framework on pesticide management for all public and private entities engaged in, or associated with, production, regulation, and management of pesticides. The new Code of Conduct on Pesticide Management (2013) provides standards of conduct in relation to sound pesticide life cycle management practices, in particular for government authorities and the pesticide industry. The Code of Conduct is supported by technical guidelines developed by the Panel of Experts on Pesticide Management.
The Convention on Biological Diversity (CBD)		5 June 1992 (A) / 29 December 1993 (E)	The CBD provides that conservation and sustainable use of biological diversity is of critical importance for meeting the food, health, and other needs of the world population. The Strategic Plan for Biodiversity 2011-2020, including the Aichi Biodiversity Targets adopted by Parties, calls for a decrease in pollution as one of the direct pressures on biodiversity.
	Cartagena Protocol on Biosafety	29 January 2000 (A) / 11 September 2003 (E)	This Protocol aims to protect biological diversity and human health from potential risks arising from the import and export of living modified organisms and the possible adverse effects of the products of modern biotechnology.
	Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety	15 October 2010 (A) / 5 March 2018 (E)	This Protocol contributes to the conservation and sustainable use of biological diversity by providing international rules and procedures for liability and redress relating to living modified organisms.
The United Nations Framework Convention on Climate Change (UNFCCC)		9 May 1992 (A) / 21 March 1994 (E)	The UNFCCC presents the framework on how to tackle climate change, including pollution challenges that contribute to climate change. Article 4(1)(f) surmises that Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives, and circumstances, shall take climate change considerations into account, to the extent feasible, with a view to minimizing adverse effects on such things as public health and the environment. The goal of the Marrakech Declaration for Health, Environment and Climate Change is to reduce pollution-related deaths by promoting better management of environmental and climate risks to health.
	Kyoto Protocol for Climate Change	11 December 1997 (A) / 16 February 2005 (E)	This Protocol objectively aims to stabilize the levels of greenhouse gases in the earth's atmosphere with the aim of stalling global warming. It is argued that stabilizing greenhouse gases, which are major pollutants, could contribute to the abatement of environment and health risks.

Agreement	Protocol(s)	Adopted (A) / Entered Into Force (E)	Summary
	Paris Agreement on Climate Change	12 December 2015 (A) / 4 November 2016 (E)	Its objective is to hold the increase in the global average temperature to well below 2°C, increase the ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development. This can only be achieved if Parties undertake to control the emissions of climate/ air pollutants and rapidly reduce greenhouse gas emissions.
The International Convention on Civil Liability for Oil Pollution Damage (CLC)		29 November 1969 (A) / 19 June 1975 (E)	The CLC was adopted to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. It places liability for such damage on the owner of the ship from which the polluting oil escaped or was discharged. It covers pollution damage resulting from spills of persistent oils suffered in the territory, including the territorial sea, of a State Party to the Convention.
The United Nations Convention to Combat Desertification (UNCCD)		17 June 1994 (A) / 26 December 1996 (E)	The UNCCD requires Parties to combat desertification and mitigate the effects of drought. Through Annexes it may address the unsustainable exploitation of water resources leading to serious environmental damage, including chemical pollution, salinization, and exhaustion of aquifers.
The Convention on the Law of the Non-Navigational Uses of International Watercourses		21 May 1997 (A) / 17 August 2014 (E)	This Convention commits Watercourse States to, individually and, where appropriate, jointly, prevent, reduce, and control the pollution of an international watercourse that may cause significant harm to other watercourse States or to their environment, including harm to human health, to the use of the waters for any beneficial purpose, or to the living resources of the watercourse.
The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management		5 September 1997 (A) / 18 June 2001 (E)	This Convention applies to spent fuel and radioactive waste resulting from civilian nuclear reactors and applications and from military or defense programs if and when such materials are transferred permanently to and managed within exclusively civilian programs, or when declared as spent fuel or radioactive waste for the purpose of the Convention by the Contracting Party. The Convention also applies to planned and controlled releases into the environment of liquid or gaseous radioactive materials from regulated nuclear facilities.
The Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade		10 September 1998 (A) / 24 February 2004 (E)	The Convention aims to control substances likely to cause pollution and harm human health and the environment. It seeks to promote shared responsibility and cooperative efforts among Parties in the international trade of hazardous chemicals, as well as contribute to the environmentally sound management of these chemicals when their use is permitted by facilitating safe handling and use and providing for a national decision-making process on their import and export.
The Stockholm Convention on Persistent Organic Pollutants		22 May 2001 (A) / 17 May2004	This Convention reaffirms Principle 16 of the Rio Declaration and seeks to protect human health and the environment from persistent organic pollutants. The Convention calls upon Member States to restrict and ultimately eliminate the production, use, trade, release, and storage of persistent organic pollutants.
International Health Regulations (IHR)		2005	These regulations are meant to help the international community prevent and respond to public health risks and emergencies that can have devastating impacts on human health and economies.

Agreement	Protocol(s)	Adopted (A) / Entered Into Force (E)	Summary
The Strategic Approach to International Chemicals Management (SAICM)		6 February 2006 (A)	SAICM is a policy framework designed to promote chemical safety around the world. Its objective is to achieve sound management of chemicals throughout their life cycle so that by 2020 chemicals are produced and used in ways that minimizes adverse impacts on human health and the environment. SAICM is, however, not legally-binding like other Conventions.
Minamata Convention on Mercury		10 October 2013 (A) / 16 August 2017 (E)	The Convention's objective is to protect the human health and the environment from the adverse effects of mercury and mercury compounds. Its preamble recognizes the substantial lessons of Minamata Disease, in particular the serious health and environmental effects resulting from the mercury pollution, and the need to ensure proper management of mercury and prevent such events in the future.

Annex 2: Distribution of Coral Reefs in the Region, Threats from Human Activities, and Economic Losses

Table A2.1 Threats to Reefs

Country	Reef area km²	Reef area % of region	Reefs at risk threat index (a)			Individual threats (b)							
						Coastal development %		Sediment and pollution from inland sources %		Marine-based source of pollution %		Fishing pressure %	
			Medium	High	Very high	Medium	High	Medium	High	Medium	High	Medium	High
Bahamas	3,580	14	24	2	-	5	-	-	-	1	-	21	1
Belize	1,420	5	29	32	2	11	-	20	29	8	-	30	7
Colombia	2,060	8	24	19	1	7	7	16	8	3	-	25	14
Cuba	3,290	13	32	33	3	14	7	20	8	7	1	35	33
Dominican Republic	1,350	5	8	63	10	22	37	24	21	6	4	11	68
Haiti	1,260	5	-	45	55	33	59	8	91	7	-	-	100
Honduras	1,120	4	13	21	-	11	14	7	3	5	1	24	5
Jamaica	1,010	4	2	34	32	24	32	19	42	24	7	2	67
Mexico	1,220	5	20	20	10	15	15	2	12	10	7	29	20
Nicaragua	870	3	11	2	-	2	2	1	-	1	-	14	-
Panama	1,600	6	16	75	10	12	8	18	82	28	8	98	2

Source: Burke and Maidens 2004.

Country	Reef area km²	Reef area % of region	Reefs at risk threat index (a)			Individual threats (b)							
						Coastal development %		Sediment and pollution from inland sources %		Marine-based source of pollution %		Fishing pressure %	
			Medium	High	Very high	Medium	High	Medium	High	Medium	High	Medium	High
Puerto Rico	1,610	6	8	59	25	30	24	32	31	20	8	8	84
Turks and Caicos	1,190	5	46	4	-	9	4	-	-	2	-	49	-
United States	840	3	48	14	-	31	11	-	-	3	-	56	3
Virgin Islands (U.S.)	590	2	9	73	18	39	18	34	-	22	22	13	87
Regional Total	25,960	100	21	33	10	17	16	15	20	10	4	29	32

Source: Burke and Maidens 2004.

Table A2.2 Threatened Economic Value of Coral Reefs in the Caribbean Region

Country	Reef area km²	Reefs at risk index %		Threatened economic value US$ million/year	
		High	Very high	High	Very high
Bahamas	3,580	2	-	9.7	
Belize	1,420	32	2	61.7	3.8
Colombia	2,060	19	1	53.2	2.8
Cuba	3,290	33	3	147.5	13.3
Dominican Republic	1,350	63	10	115.5	18.3
Haiti	1,260	45	55	77.0	93.5
Honduras	1,120	21	-	31.9	
Jamaica	1,010	34	32	46.6	43.6
Mexico	1,220	20	10	33.1	16.5
Nicaragua	870	2	-	2.4	
Panama	1,600	75	10	163.0	21.6
Puerto Rico	1,610	59	25	129.0	54.4
Turks and Caicos	1,190	4	-	6.5	
United States	840	14	-	16.0	
Virgin Islands (U.S.)	590	73	18	58.5	14.4
Regional Total	25,960	33	10	1,163.6	350.5

Source: Burke and Maidens 2004.
Note: Threatened economic value uses the mean economic contribution of US $0.135 million/km²/yr and applies it to the extension percentages of high and very high reef risk. Numbers may not add to totals due to rounding and because not all countries are included in the table.

Annex 3: Mangrove Coverage in the Caribbean Region

Table A3.1 Mangrove Area in the Caribbean Region

Country/Territory	Area (km^2) from FAO, 2010			Area (km^2) from Spalding et al. 2010
	2000	2010	2010/2000	
Anguilla	0.9	0.9	100	
Antigua and Barbuda	8.5	6.69	79	8.43
Aruba	4.2	4.2	100	
Bahamas	1,420	1,420	100	875.05
Barbados	0.07	0.07	100	0.04
Belize	983	1,041	106	957.3
Bermuda	0.16	0.15	94	0.18
British Virgin Islands	5.91	5.54	94	
Cayman Islands	70	70	100	
Colombia	2,886	2,889	100	4,079
Costa Rica	420.8	411.8	98	418.4
Cuba	5,390	6,360	118	4,944
Dominica				
Dominican Republic				212.15
French Guyana				692.7
Grenada	1.8	1.8	100	
Guadeloupe	75	75	100	
Guatemala	177	144	81	
Haiti	143	131	92	
Honduras	540	420	78	628
Jamaica	97	96	99	97.55
Martinique	20	20	100	
Mexico	8,960	8,960	100	7,700.5
Mexico (Q. Roo)				647.6

Country/Territory	Area (km²) from FAO, 2010			Area (km²) from Spalding et al. 2010
	2000	2010	2010/2000	
Montserrat	0	0		
Netherlands Antilles	11	11	100	
Nicaragua		289		670.7
Panama	1,740	1,740	100	1,744
Puerto Rico	79.2	79.2	100	74
St. Kitts and Nevis	0.14	0.14	100	
St. Lucia	1.6	1.6	100	1.91
St. Vincent and the Grenadines	0.34	0.34	100	
Suriname				509.78
Trinidad and Tobago	53.72	53.72	100	65.7
Turks and Caicos Islands	236	236	100	236
United States	1,980	1,900	96	3,029.6
Venezuela	2,310	2,160	94	3569
Regional Total	27,616.34	28,529.15	103	30,516.59
Virgin Islands (U.S.)	1	1	100	2.6

Annex 4: Targeted Intervention Options

The following section identifies a number of targeted options for the abatement of major land-based sources of pollution of the marine environment in the Caribbean region. The different options are in line with existing initiatives and cost-effective technologies. This section also discusses environmental and other factors which should be considered when selecting the best possible interventions within the context of SIDS countries.

Although cost-effectiveness criteria are important, several other factors may play an important role in selecting an intervention.[19]

- Financing
- Level of skills and effort/resources needed for operation and management
- Level of environmental friendliness (related to assessment of effects)
- Cultural acceptability
- Regional applicability/use
- Potential barriers to implementation

4.1 Wastewater treatment

The targeted interventions aim at integrating water and wastewater supply and treatment, following the principles of Integrated River Basin Planning and Integrated Urban Water Management (IUWM). IUWM is a flexible, participatory, and iterative process. It integrates the water cycle with urban development and river basin management to maximize economic, social, and environmental benefits. This strategic approach moves away from ad hoc and isolated waste water management.

Long-term sustainability is also key to guiding wastewater management solutions. Infrastructure should be planned and designed commensurate with the proper technical capacities, financial mechanisms and capacities (including public and private resources), and institutional designs.

Some guidelines for considering wastewater management include the following.

- Existing systems that do not operate at maximum capacity should be optimized.
- In urban areas, centralized systems may be more cost-effective, due to restricted land availability and high costs of land.
- In urban areas where there is a sewage collection infrastructure but no treatment of collected sewage, the cost of having an operating sewage system with treatment is relatively low.
- Industrial waste and wastewater that run into domestic sewage systems should receive extra care, as they can ruin operations and restrict reuse options.
- In less densely populated areas with more low-cost land available (that is, land that does not have a high alternative value in use in agriculture, forest, development, and so on), decentralized systems may be more cost-effective. Different systems exist and should be adapted to local conditions, using previous studies' evaluation of different systems with respect to cost and effects.
- Solutions that are technically not advanced and easily and cheaply operated have proved beneficial because they are often properly managed, keep up the treatment effects in the long run, and do not impose large costs on the water utility.
- Treated wastewater and wastes from treatment processes should be seen as a re-usable resource—but one that needs to be used wisely and safely to avoid health problems.

A major weakness for Caribbean countries is the inadequate legal framework for wastewater. In general, all countries have similar issues with respect to their policy, legislative, and institutional framework for wastewater management, with 38 percent of countries having a weak policy and legislative framework. About 23 percent have made considerable progress and are using a comprehensive framework for wastewater management. Less than 10 percent have legislation that focuses on wastewater

19 GEF CReW project.

Table A4.1 Assessment of factors in anti-pollution technology

Appropriate technology	Relative cost (high, medium, low)	Level of O&M	Environ-mentally-friendly	Cultural acceptability	Use in the Caribbean region	Potential barriers to implementation
Rotating biological contractors	High	Skilled labor required	High	Yes	Not widely used. Used successfully in St. Kitts and St. Lucia	High energy requirement. Energy required on a 24/7 basis for bacterial activity
Sequential batch reactors	High	High O&M, Requires skilled installation	High	Yes	Limited use. Growing use in Antigua, St. Kitts, Trinidad and Tobago, Barbados and St. Lucia	Requires electricity. Only receives liquid waste. Requires reliable water supply
Membrane reactor	Moderate		High	Yes	Increasing use within the region	Requires electricity. Requires reliable water supply.
Imhoff tanks	Low	Requires removal of scum and sludge at regular intervals	Moderate	Yes	Limited use in the Caribbean	Effluent requires tertiary treatment
Activated sludge process	High	Skilled labor required	High	Yes	Widely used	High energy requirement for bacterial activity
Constructed wetland	Low	Low. Plants require maintenance/ manual harvesting	High	Yes. Growing	Moderate use (St. Lucia,Grenada, Jamaica)	Large land area Pest/ insect control
Anaerobic ponds	Low	Low	High	Yes	Increasing use in the region	Land space. Pest and odor control
Facultative ponds	Low	High	Moderate	Yes	Increasing use in the region	Land space High energy use if mechanical aerators are used
Maturation Ponds	Low	Low	High	Yes	Increasing use in the region	Land space
Upflow anaerobic sludge blanket (USAB) reactor	Low	Low	High	Limited	In Jamaica for agro-industrial wastewater and centralized sewerage systems.	Startup time not immediate
Conventional sewerage	High	High	Moderate	Yes	Widely used in major cities	Technology requires skilled engineers. High, reliable water supply
Small bore (settled) sewerage	Low	High-skilled personnel	Moderate	Yes	Increasing use, e.g., Grenada	Technology requires engineering skills.

Source: GEF CReW Project report.

management. Belize is one of the exceptions, having modified its effluent regulations to include domestic sewage.

Across the region there is also fragmentation of legislative instruments for wastewater management, from protection of public health to conservation of ground and surface freshwater resources. To address this weakness, wastewater policy should put forward guidance on the following issues (GEF CReW 2015):

- A definition of "wastewater"
- Institutional arrangements for the administration of relevant legislation and coordination with relevant

authorities (such as planning, environment, tourism, and health)

- Identification of the ownership of wastewater
- Specifications for a system of licensing that introduces taxation that makes the wastewater utility self-financing
- Mechanisms for reduction of pollution loads
- Any restrictions that provide for the protection of public and environmental health with respect to:
  - Intended use of the wastewater
  - Treatment conditions and final quality of wastewater
  - Conditions for the location of wastewater treatment facilities
  - The control of wastewater discharges
  - Disposal of sludge that results from wastewater treatment
- Water standards and compliance guidelines and mechanisms for their use
- Enforcement and compliance mechanisms including fees and penalties
- Cost allocation and pricing through an economic-technical model

Table A4.1 provides a summary of several waste water treatment systems for the Caribbean, their costs, effects, and other relevant factors for their selection. While costs and effects for the different systems are not quantified, the table provides a qualitative assessment of the factors involved in the selection of a particular technology.[20]

4.2 Integrated Litter Management

For integrated litter management, a targeted strategy should include a balance of priority and mutually reinforcing measures with short-term impact, as well as cost-effective measures with long-term impact (see Figure A4.2). These include:

- Planning controls: Urban and tourism planning to avoid littering activities in key areas for drainage and aesthetics
- Source controls: Avoiding the generation of litter (solid waste collection, sweeping, bag bans, public awareness), including financing and contracting of solid waste systems
- Downstream controls: Intercepting or cleaning up litter once it is produced (trash traps, cleaning and clean-up in watershed, coastal or marine environments)

Planning controls will entail integrated planning of urban development and water services, including:

- Protection of water quality and water resources
- Controls that restrict litter-generating activities to areas where they can be effectively controlled and potential impacts can be reduced
- Preserving elements of natural stormwater system such as natural channels, wetlands, and riparian vegetation

Source controls will include measures that reduce litter loads entering draining systems. There are four main categories of source controls:

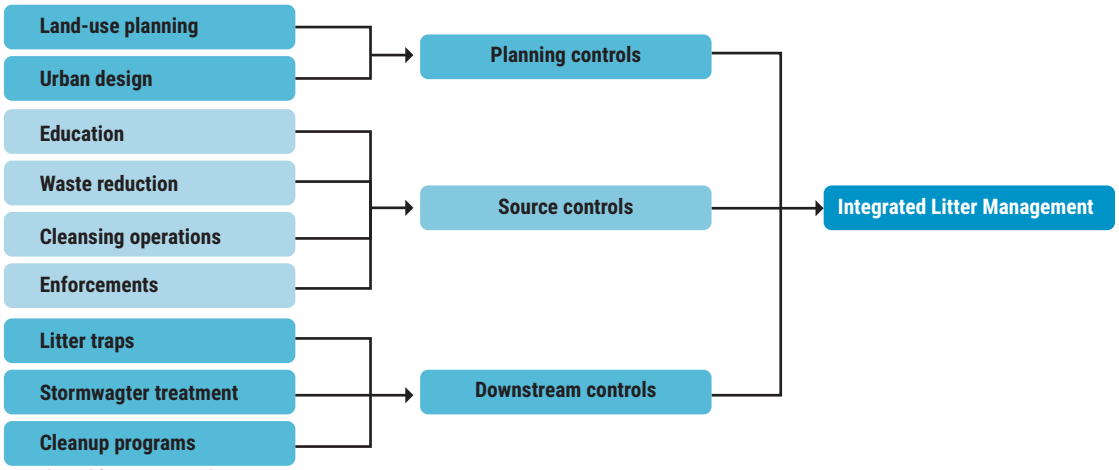
- Educational campaigns
- Waste reduction efforts
- Cleansing operations
- Law enforcement mechanisms

Downstream controls are important as source controls cannot prevent all litter from entering a drainage system. Downstream action can include physical barriers and removal mechanisms to prevent litter from clogging the drainage system and harming the environment. In addition, effective controls as part of an IUWM approach enable use or reuse for various purposes downstream (e.g. restoring wetlands and land conservation). Options for downstream control may include:

- Installation of grills over catchpit entrances
- For combined sewer systems (those that convey both wastewater and stormwater), removal can be achieved at the wastewater treatment plant

20 This information was adapted from a GEF CReW Project report.

Figure A4.2 Solving the Problem—Integrated Litter Management Strategy



Source: Adapted from Marais and Armitage 2004.

- For separated sewer systems, litter must be trapped and removed along the sewer system prior to discharging to waterways.

4.3 Industrial and chemical pollutants control

The following are targeted interventions for industrial and chemical pollutants control in the Caribbean. These are aligned with UNEP's "Towards a Pollution-Free Planet" report (UNEP 2017).

- Optimize fertilizer use in agriculture and enhance nutrient management and plant uptake efficiency to reduce excess nutrient run-off and water contamination.
- Increase the use of non-chemical alternatives to fertilizers and pesticides and the adoption of agro-ecological practices.
- Control the use of antimicrobials in the livestock sector to avoid releases into the environment.
- Support improvements in pollutant inventory systems, especially for mining, and make sustainability reporting mandatory.
- Provide funding for long-term environmental monitoring after a mining site is closed, to ensure that rehabilitation is effective.
- Identify and characterize pollution- and chemical-related hotspots (such as obsolete stockpiles of chemicals and contaminated sites) to protect vulnerable groups and the environment, minimize exposure, and take measures to decontaminate them and prevent new ones.
- Reduce and mitigate risks associated with extractive activities, including controlling the use and release of chemicals in mining, and mercury in artisanal and small-scale gold mining.
- Effectively provide and apply reliable information along the product life cycle, including at the consumer stage, in particular on the presence of harmful chemicals in manufactured products, and raise consumer awareness of hazards and risks throughout the value chain.
- Develop eco-labelling schemes to inform customers on the potential environmental and health impact of their consumer choices.
- Reduce exposure to lead through actions on battery recycling, pottery, and paint.
- Phase out mercury use in a number of specific products by 2020 and manufacturing processes by 2025, and phase down use of mercury in dental amalgam and in mining.

Annex 5: Blue Economy Principles and Approaches for the WCR

Box A5.1 Principles and Description for Protecting the Marine Environment

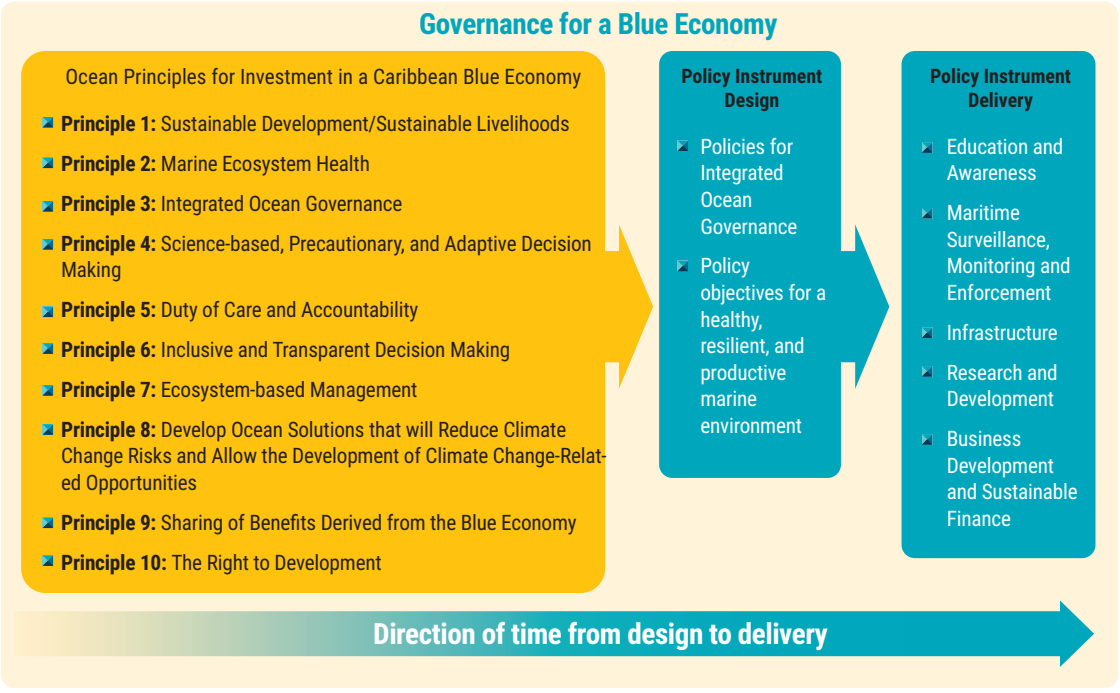
No.	Principle	Description
1	Sustainable Development/ Sustainable Livelihoods	This principle recognizes the importance of marine ecosystems in delivering essential goods and services that underpin the livelihoods of millions of people by contributing to food security, poverty eradication, livelihoods, income, employment, health, safety, equity, and political stability. Central to this principle is the need to align the use of resources to optimize the well-being of people today and in perpetuity.
2	Marine Ecosystem Health	The diversity, health, and productivity of marine ecosystems are fundamental to the management of both the oceans and the land. The diversity, productivity, and core functions of marine ecosystems must be maintained, restored, and protected with a goal of maintaining or recovering natural levels of the natural capital upon which prosperity depends.
3	Integrated Ocean Governance	Integrated governance is a commitment to planning and managing human activities in a comprehensive manner while considering all factors necessary for the conservation and sustainable use of marine resources and the shared use of ocean spaces. Inherent to this principle are initiatives that produce change in management practices to enable a rapid shift toward the sustainable use of marine and coastal resources. The goal is to support or design effective innovative governance systems that provide incentives to private and public sector leaders at all levels to engage and support a healthy ocean and community well-being.
4	Science-Based, Precautionary and Adaptive Decision Making	Ocean planning and management decisions should be based as far as possible on the best available information on the natural, social, and economic processes that affect ocean and coastal environments. When adequate information and knowledge are not available, decision makers should take a precautionary approach, actively seek to develop the relevant knowledge, and refrain from undertaking activities that could potentially lead to harmful effects. Adaptive management allows decision-making to respond to the availability of new information concerning risks and sustainable opportunities.
5	Duty of Care and Accountability	All users of the marine environment take responsibility for the impacts of their activities, by taking appropriate action, as well as by being transparent about their impacts so that stakeholders are well informed and can exert their influence.
6	Inclusive and Transparent Decision Making	Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately. A sustainable Blue Economy should therefore be based on active and effective stakeholder engagement and participation. It is also critical that decision-making processes are conducted in a manner that is transparent and accountable to minimize the likelihood of disputes and to promote international cooperation. For the Blue Economy to be a success, partnerships between government, the private sector, and civil society must be built to ensure co-responsibility for ocean management and to empower stakeholders to participate effectively.

Source: Patil et al. 2016.

No.	Principle	Description
7	Ecosystem-Based Management	There is a need to move away from the sectoral and species-based approaches that characterize our current approach to managing the marine environment. Ecosystem approaches need to be further refined and made operational. Large-scale MSP and networks of MPAs and other area-based management measures for biodiversity conservation purposes should be integral parts of the Blue Economy. Such processes must be participatory, accountable, transparent, equitable, and inclusive, so as to be responsive to present and future human uses and needs, including the needs of minorities and the most vulnerable groups in society. To make informed trade-offs, such processes should also use appropriate tools and methods to capture the range of benefits that ecosystem goods and services can bring to different stakeholders.
8	Ocean Solutions that Reduce Climate Change Risks and Allow Climate Change-Related Opportunities	Sustainable energy provision is fundamental to the transition to a low-carbon economy, and the basis for progressing toward sustainable development globally. It is critical in ensuring progress in areas such as food, water, health, gender equality, and poverty alleviation.
9	Sharing of Benefits Derived from the Blue Economy	The benefits from the use of common ocean resources, and the responsibilities for their continued health and productivity, should be shared by all citizens. Governments should govern marine resource use based on the interests of the whole community and the interests of intergenerational equity. Economic instruments such as taxes, subsidies, and fees can help by internalizing environmental and social benefits, costs, and risks to society of ocean use
10	The Right to Development	Human development in harmony with the environment is fundamental to the achievement of sustainable development, so that individuals and societies are empowered to achieve positive social and environmental outcomes. The value of the resources provided by the oceans must be recognized and opportunities for their economic development optimized to meet society's needs and promote the well-being of coastal communities.

Source: Patil et al. 2016.

Box A5.2 Governance for a Blue Economy



Source: Patil et al. 2016.

Box A5.3 Approach for the Transition to a Caribbean Blue Economy

Measure.

- Improve the statistical and methodological base for measuring the scale and performance of the ocean economy.
- Establish natural capital accounts for the Caribbean Sea at the national and regional levels.

Manage.

- Create and expand integrated approaches to ocean governance.
- Apply marine spatial planning at the scale of exclusive economic zones.
- Invest in restoration and maintenance of the function and integrity of critical marine ecosystems.
- Build and strengthen the institutional and human capacity to act.

Invest.

- Promote ocean principles to guide investment in the blue economy.
- Advance key infrastructure investments.

Monitor.

- Continue to enhance knowledge of the Caribbean Sea.
- Expand maritime domain awareness of the Caribbean Sea.
- Track key indicators of the transition to a blue economy.

Repeat.

- Keep close track of actions and progress and adjust as needed.

Annex 6: Methodology for Household Collection Services Data

Sources used

The household waste volumes presented in Chapter 3 (in tons per year) were derived from country- specific reports containing discussions of solid waste management in different capacities. Recent waste characterization studies conducted by a country's solid waste management authority were given primary priority. Likewise, annual reports from these institutions served as primary sources of information. Country-specific official population surveys and censuses that included statistics related to waste management were also considered as primary sources. Where neither of these documents was available or comprehensive enough, secondary sources of information such as waste management reports conducted by international organizations, NGOs, or other entities, were used. Quality control and data corroboration of secondary sources was carried out by cross referencing different sources and often reviewing their cited references as well.

Why household data

The greater availability of data on public collection services, which often included household and institutional waste collection, served as a point of commonality among countries. The wide availability of official population surveys also served to cross reference reported estimates of waste generation at the household level. Sources of information report, by contrast, businesses and industries using private collection services, for which less reliable information was available.

Reporting values

A spreadsheet database was prepared to organize the key information useful for deriving the estimates of uncollected waste in this report, including plastic waste presented (see table below).

A summary of key variables used in the estimation of uncollected waste, including plastic, follows in Box A6.1.

Calculation of estimates

- Household collection coverage: Number of households (or people) reported with collection service divided by total households (or people)
- Proportion of uncollected waste: 100% minus household collection coverage.
- Total household waste generated***: Reported waste volumes at the household level divided by household collection coverage

***Adding the estimated proportion of waste that does not make it to the landfill since it is here where waste is weighted and values reported.

- Total uncollected household waste: Total household waste generated times proportion of uncollected waste
- Uncollected household plastic: Total uncollected household waste times reported fraction of plastic waste
- Average waste composition: Using the waste characterization information for the countries, the average of each category was calculated and reported as proportions of the total.

Box A6.1 Key Variables in Estimation of Uncollected Waste

Information collected	Unit	Source
Reference source information		
Country's total population and household population	Number of people	National census
Total number of households with collection services	Number of households or/people*	National census
Reported waste volumes at the household level	Tons per year	Waste characterization studies; annual reports; or others when appropriate
Household waste collection coverage	%	Waste characterization studies; annual reports; or others when appropriate. Sometimes calculated when not available.
Reported fraction of plastic waste	%	Waste Characterization studies
Calculated values		
Household collection coverage	%	Calculated when not available in the literature.
Proportion of uncollected waste	%	Calculated.
Total household waste	Tons per year	Calculated.
Total uncollected household waste	Tons per year	Calculated.
Uncollected household plastic	Tons per year	Calculated.
Average waste composition	%	Calculated.

*The census often reported the total household population and the average number of people per household, facilitating, therefore, their use interchangeably.

Annex 7: Status of Ratification of Relevant International Conventions

Cartagena Convention and its Protocols							
Country	Cartagena Convention	Oil Spill Protocol		Specially Protected Areas and Wildlife (SPAW)		Land Based Sources of Pollution (LBS)	
	Ratified / Acceded	Date of Signature	Ratified / Acceded	Date of Signature	Ratified / Acceded	Date of Signature	Ratified / Acceded
Antigua and Barbuda	1986		1986	1990			2010
Bahamas	2010		2010		2010		2010
Barbados	1985	1984	1985		2002		
Belize	1999		1999		2008		2008
Colombia	1988	1983	1988	1990	1998	2000	
Costa Rica	1991		1991			1999	2016
Cuba	1988		1988	1990	1998		
Dominica	1990		1990				
Dominican Republic	1998		1998		1998	2000	2012
France*	1985	1983	1985	1990	2002	1999	2007
Grenada	1987	1983	1987		2012		2012
Guatemala	1989	1983	1989	1990			
Guyana	2010		2010		2010		2010
Haiti							
Honduras		1983					
Jamaica	1987	1983	1987	1990			2015
Mexico	1985	1983	1985	1990			
Netherlands*	1984	1983	1984	1990	1992	1999	
Nicaragua	2005	1983	2005				
Panama	1987	1983	1987	1991	1996		2003
St. Kitts and Nevis	1999		1999				
Saint Lucia	1984	1983	1984	1990	2000		2008
St. Vincent and the Grenadines	1990		1990	1991	1991		
Suriname							
Trinidad and Tobago	1986		1986	1990	1999		2003

* These countries have dependent overseas territories/administrative departments in the Caribbean: France – Martinique, Guadeloupe, Sint Maartin, and French Guiana; Netherlands – Aruba, Bonaire, Curaçao, Saba, Sint Eustatius, Sint Maarten; United Kingdom – Anguilla, Bermuda, the Cayman Islands, Turks and Caicos Islands, Montserrat and the British Virgin Islands; United States of America – Puerto Rico, U.S. Virgin Islands.
Sources: http://www.cep.unep.org/pubs/legislation/cartstatus.html; http://www.cep.unep.org/cartagena-convention

Cartagena Convention and its Protocols							
Country	Cartagena Convention	Oil Spill Protocol		Specially Protected Areas and Wildlife (SPAW)		Land Based Sources of Pollution (LBS)	
United Kingdom*	1986	1983	1986	1990			
United States of America*	1984	1983	1984	1990	2003	1999	2009
Venezuela	1986	1983	1986	1990	1997		
European Economic Commission							

* These countries have dependent overseas territories/administrative departments in the Caribbean: France – Martinique, Guadeloupe, Sint Maartin, and French Guiana; Netherlands – Aruba, Bonaire, Curaçao, Saba, Sint Eustatius, Sint Maarten; United Kingdom – Anguilla, Bermuda, the Cayman Islands, Turks and Caicos Islands, Montserrat and the British Virgin Islands; United States of America – Puerto Rico, U.S. Virgin Islands.
Sources: http://www.cep.unep.org/pubs/legislation/cartstatus.html; http://www.cep.unep.org/cartagena-convention

Other Relevant Convention									
Country	MARPOL	CBD	UNCCD	UNFCCC	UNCLOS	CNWH	RAMSAR	CITES	Basel
Antigua and Barbuda	X	X	X	X	X		X	X	X
Bahamas	X	X	X	X	X		X	X	X
Barbados	X	X	X	X	X		X	X	X
Belize	X	X	X	X	X		X	X	X
Colombia	X	X	X	X	X (signatory only)	X (signatory only)	X	X	X
Costa Rica		X	X	X	X	X	X	X	X
Cuba	X	X	X	X	X	X	X	X	X
Dominica	X	X	X	X	X				X
Dominican Republic	X	X	X	X	X	X	X	X	X
France	X	X	X	X	X		X	X	X
Grenada		X	X	X	X		X	X	
Guatemala	X	X	X	X	X	X	X	X	X
Guyana	X	X	X	X	X			X	X
Haiti		X	X	X	X	X			X (signatory only)
Honduras	X	X	X	X	X		X	X	X
Jamaica	X	X	X	X	X		X	X	X
Mexico	X	X	X	X	X	X		X	X
Netherlands	X	X	X	X	X		X	X	X
Nicaragua	X	X	X	X	X	X	X	X	X
Panama	X	X	X	X	X	X	X	X	X
St. Kitts and Nevis	X	X	X	X	X			X	X
Saint Lucia	X	X	X	X	X		X	X	X

Unless otherwise stated, X =treaty ratification, accession, approval, and/or acceptance.
Sources: https://www.ukpandi.com/knowledge-publications/article/imo-conventions-and-signatory-countries-207/ (MARPOL)
https://www.cbd.int/information/parties.shtml (CBD); https://knowledge.unccd.int/home/unccd-terminology/overview-countries-unccd-annex (UNCCD);
https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states (UNFCCC); http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm (UNCLOS); http://www.oas.org/juridico/english/sigs/c-8.html (CNWH); http://www.cep.unep.org/pubs/Techreports/tr36en/index.html#profiles (CNWH); https://www.ramsar.org/country-profiles (RAMSAR); https://www.cites.org/eng/disc/parties/chronolo.php (CITES);
http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx (Basel)

Other Relevant Convention									
Country	MARPOL	CBD	UNCCD	UNFCCC	UNCLOS	CNWH	RAMSAR	CITES	Basel
St. Vincent and the Grenadines	X	X	X	X	X			X	X
Suriname	X	X	X	X	X	X	X	X	X
Trinidad and Tobago	X	X	X	X	X	X	X	X	X
United Kingdom	X	X	X	X	X		X	X	X
United States of America	X	X (signatory only)	X	X	X (Only certain sections of the convention)		X	X	X (signatory only)
Venezuela	X	X	X	X		X	X	X	X

Unless otherwise stated, X =treaty ratification, accession, approval, and/or acceptance.
Sources: https://www.ukpandi.com/knowledge-publications/article/imo-conventions-and-signatory-countries-207/ (MARPOL) https://www.cbd.int/information/parties.shtml (CBD); https://knowledge.unccd.int/home/unccd-terminology/overview-countries-unccd-annex (UNCCD); https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states (UNFCCC); http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm (UNCLOS); http://www.oas.org/juridico/english/sigs/c-8.html (CNWH); http://www.cep.unep.org/pubs/Techreports/tr36en/index.html#profiles (CNWH); https://www.ramsar.org/country-profiles (RAMSAR); https://www.cites.org/eng/disc/parties/chronolo.php (CITES); http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx (Basel)

Definitions:

Convention	Definition
MARPOL	Convention for the Prevention of Pollution From Ships
CBD	Convention on Biological Diversity
UNCCD	UN Convention to Combat Desertification and Land Degradation
UNFCCC	UN Framework Convention on Climate Change
UNCLOS	UN Convention of the Law of the Sea
CNWH	Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere
RAMSAR	RAMSAR Convention on Wetlands
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Basel	Basel Convention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