STRATEGIC SARGASSUM PREPAREDNESS PLAN

Prepared for:

FISHERIES DIVISION OF DOMINICA

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Prepared by:

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April 5, 2019

Fisheries Division
Ministry of Agriculture, Food and Fisheries
Government Headquarters
Commonwealth of Dominica

Subject: **Strategic Sargassum Preparedness Plan**
Attention: **Mr. Kurt Hilton, Fisheries Officer**

Dear Mr. Hilton,

On behalf of Resilify Incorporated (Inc.), I am pleased to provide the Fisheries Division of the Government of Dominica with this Strategic Sargassum Preparedness Plan. Based on our research including a comprehensive literature review and extensive stakeholder consultation, Resilify Inc. has developed an effective, innovative and sustainable Preparedness Plan to manage the sargassum influxes that Dominica has been experiencing since 2012. The Preparedness Plan includes short and long-term strategies that provide objective recommendations which specifically address both larger and smaller influxes of sargassum.

Our team would like to thank the Fisheries Division for the opportunity to collaborate in developing this Preparedness Plan. Should any questions or comments arise in regards to the Plan, please do not hesitate to contact me.

Kind regards,

Jeremy Kruizinga
Project Manager
resilifyinc@gmail.com

Acknowledgement

The Resilify Inc. team has enjoyed the challenges and learning opportunities presented while developing the Strategic Sargassum Preparedness Plan. Our team would like to express our sincerest gratitude to Mr. Kurt Hilton for diligently collaborating with us. We are extremely proud of the work we have completed with the Fisheries Division to develop a Strategic Sargassum Preparedness Plan and are eager to see our recommendations being implemented. Resilify Inc.'s focus on feasible and implementable management strategies ensures that Dominica will be able to appropriately plan and manage influxes of sargassum today and in the future.

Resilify Inc. must also thank Dr. Jeremy Pittman for his ongoing feedback and Dominica-specific knowledge. Dr. Pittman provided essential insights and resources that allowed the Resilify Inc. team to develop the Strategic Sargassum Preparedness Plan successfully.

TABLE OF CONTENTS

Table of Contents

List of Appendices

List of Figures

List of Tables

1.0 INTRODUCTION

1.1 What is the Strategic Sargassum Preparedness Plan?

The Commonwealth of Dominica is a small Caribbean island located in the lesser Antilles. Dominica is known for untouched nature and beautiful white sand, black sand, and rock beaches. Over the past seven years, Dominica has been facing an unprecedented influx of sargassum. This phenomenon is not unique to Dominica, as many other Caribbean islands and coasts across the globe are being affected. In comparison with other Caribbean islands, Dominica experiences a lesser quantity and greater inconsistency of sargassum influxes. However, sargassum has caused many negative externalities which affect the Dominican people, economy, and physical environment.

Resilify Inc. conducted extensive research and stakeholder consultation to develop both long-term and short-term strategies to address the sargassum influxes in Dominica. The consulted stakeholders were representatives from both the private and public sector. Our strategies further specify targeted actions, which can be tailored to the level of sargassum influx being experienced on the coast of Dominica.

Figure 1: Sargassum Influx on Beach [1]

1.2 Why was the Plan Developed?

This document is prepared in response to the Request For Proposal (RFP) issued by the Fisheries Division of Dominica in January 2019. In response, Resilify Inc. has developed a Strategic Sargassum Preparedness Plan intended to provide an effective, feasible, and innovative strategy for managing the sargassum influx. This Preparedness Plan aims to address the negative impacts of the sargassum influx while taking advantage of the various positive opportunities it presents. The RFP requested Resilify Inc. to research causes, drivers, impacts, uses and the existing policy and legal framework surrounding sargassum management in Dominica. The goal of this RFP was to provide a framework for Dominica to effectively manage the sargassum influxes.

Figure 2: Map of Dominica Specific to Strategic Actions

2.0 PLAN DEVELOPMENT

The objective of the Sargassum Preparedness Plan is to address the impacts of sargassum while capitalizing from its opportunities. To thoroughly understand the current research on sargassum and how the influxes are affecting Dominica and its fisheries, research was completed through a multi-step process. A literature review and informal stakeholder consultations were chosen as the best suitable method for data collection. Through this process, contextual best management practices were determined to mitigate the influxes of sargassum in Dominica.

2.1 How was Research Conducted?

A comprehensive literature review was undertaken to gain an in-depth understanding of sargassum. The literature review includes grey and academic literature on sargassum. A wide variety of sources were reviewed and synthesized to examine what research has been completed on the effects of sargassum and potential best practices to mitigate the negative impacts of the influxes while capitalizing on the opportunities. The literature review undertaken explored topics including:

- The taxonomy of sargassum;
- Causes and drivers of the sargassum influxes;
- Socio-ecological impacts of sargassum;
- Political frameworks for sargassum management;
- Other management options; and
- Current challenges with managing sargassum.

While considering the Dominican context, research findings were analyzed and consolidated. The consolidated research findings were presented to the Fisheries Division of Dominica for comments and feedback. Research gaps and questions were identified to develop the stakeholder questionnaire.

2.2 How were Stakeholders Engaged?

Informal stakeholder consultation was undertaken with individuals affected by and interested in the influx of sargassum in Dominica. The informal consultations were conducted through email and phone correspondence. Informal consultations was identified as an effective and time-efficient way of collecting information from stakeholders.

In total, we consulted with thirteen stakeholders. A list of the stakeholders consulted can be found in **Appendix A**. Stakeholders included individuals from the tourism, agriculture, fisheries, academia, planning, economic development, and environmental (i.e. climate and resilience) sectors.

2.2.1 The Questionnaire

The objective of the stakeholder questionnaire was to gain a deeper understanding of sargassum in the Dominican context. While developing the stakeholder questionnaire, research gaps were identified in order to obtain data that was not provided in the current literature on sargassum. It is important to note that all stakeholders contacted had previous knowledge of the sargassum influx in Dominica.

Each stakeholder was asked the following questions:

- How has sargassum affected your industry / area of expertise?
- What is the most significant issue you have found with managing sargassum?
- What ways could you benefit from sargassum?
- If a committee was created to manage sargassum, what would you contribute to the team?
- Is there anything specific in your area of expertise that you have learned about sargassum that would help us manage influxes?
- Do you have any other additional comments?

2.3 How was the Plan Developed?

While developing the Strategic Sargassum Preparedness Plan, key research findings were consolidated from the literature review and stakeholder consultation. In addition, biweekly project updates were provided to the Fisheries Division of Dominica. Collaborative meetings with the Fisheries Division and additional stakeholders were scheduled to identify feasible solutions for the Preparedness Plan. Through these meetings, a better understanding of Dominica's resources, political context and other jurisdictional precedents were considered in developing the Preparedness Plan. Internal team meetings finalized the best suitable management strategies and next steps to help mitigate the influxes of sargassum in Dominica, as outlined in the Preparedness Plan. Recommended management strategies are focused on both the short and long-term, with the consideration of a concurrent five-year review.

3.0 FINDINGS

The following section outlines the key findings of the research and consultation undertaken through the development of this Preparedness Plan.

3.1 What is Sargassum?

There are over a hundred species of sargassum, however, the two most common sub-species present in the Caribbean Sea are *Sargassum natans* and *Sargassum fluitans*. Both species of sargassum are considered invasive. *Sargassum natans* has narrow leaves with spikes on the ends. It resembles tumble-weed in its structure with sparse leaves and tangled branches.[2] *Sargassum fluitans* has broader leaves and is denser in structure.[2] Both species have pods that help them lay flat. The pods of *Sargassum natans* are tipped with a spike.[3;4] Both species of sargassum do not attach to the seafloor during their life cycles since they live floating on the surface of the Sea.[5] Sargassum reproduces asexually, meaning that a new plant can grow from a fragment of the parent plant.[6] This characteristic makes removing the plant in its entirety difficult.

Figure 3: Two Types of Sargassum Present in the Caribbean [2]

3.2 What is Causing the Influxes?

Reports from the summer of 2011 saw sargassum influx levels with peak biomass 200 times higher than the previous eight years' average for the eastern Caribbean.[7] A report released by the United Nations Environmental Programme explained that it is currently not understood why the Caribbean has been experiencing recent influxes of sargassum.[8] However, satellite imagery has been used to track where the sargassum originates from.[8] It was originally speculated that the source of the sargassum influxes was the Sargasso Sea, where it then migrated to the Caribbean in a southwestward trajectory (**Appendix D**).[8] Satellite imagery has instead revealed that the influxes of sargassum can be tracked to the area dubbed by oceanographers as the North Equatorial Recirculation Region (NARR).[7;8] Some researchers endorse the theory that the sargassum influxes originated from the coast of Brazil, fed by a sargassum bloom in the NARR.[7]

There are several factors which have been identified as potential causes of the sargassum influxes in the Caribbean, such as warming ocean temperatures and increased quantities of nitrogen and phosphorus in water bodies due to human land uses.[8] Changing ocean current strengths may be causing large groups of sargassum to accumulate.[8] After some sargassum breaks off from a bloom, it is expected to then travel north and westward to the Caribbean.[8] Researchers also agreed that there is a lack of consensus regarding the causes of the sargassum influxes and describe several theories to explain this phenomenon.[9] They speculate that climate change may have caused the Sargasso Sea to travel closer to the Caribbean, or that the lack of cyclones in recent decades has created optimal conditions for sargassum growth.[9] They also put forward the hypothesis that increased nutrient levels in the Sea as a result of deforestation or larger volumes of Sahara dust in the Sea are causing sargassum growth.[9]

Sargassum migration levels vary from year to year due to fluctuations in seawater temperatures, nutrient levels, ocean currents, and wind strengths.[8] While the sargassum influxes have demonstrated very little consistency, the highest volumes of sargassum influx have occurred in the spring, summer and fall months.[8] The more protected shores of the Caribbean have largely experienced less influx than coastlines.[8]

3.3 What are the Impacts?

Thick piles of sargassum present a concern for human health as they accumulate on beaches and shorelines and prevent beach access by trapping plastics, paper, and medical waste.[10] If sargassum remains on the beach for over 48 hours, it can start to produce toxic gases that pose threats to human health, including fatal hypoxic pulmonary, neurological, and cardiovascular lesions.[11] Chronic exposure to sargassum was found to cause headaches, vestibular syndrome, memory loss, and modification of learning abilities, with more than 3,341 cases of acute exposure reported in Guadeloupe and 8,061 cases reported in Martinique in 2018.[7;11] While sargassum poses a threat if exposed to humans in large amounts, in most cases, exposure to sargassum is not harmful as the hydrogen sulphide gas released from sargassum decays occurs naturally in the human body.[12]

The presence and smell of sargassum generally have negative impacts on the tourism industry, since considerable costs are required to clean the beaches.[7;10] The foul odor from decomposing sargassum which is caused by the production of hydrogen sulfide gas (H_2S) and other organic compounds, not only discourages locals and tourists in Mexico from using the beaches but deters them from visiting the adjacent restaurants.[7] A study on sargassum influxes in Barbados found that the harvest sector was the most negatively impacted, particularly those in the flying fish industry.[13]

Sargassum presents several benefits, as it provides habitat, shelter, and a source of food for over 120 species of fish and over 120 species of invertebrates.[14] Many of these species are endangered, or are commercially profitable.[14] The removal of sargassum can cause environmental problems because there are limited regulations to outline the proper procedures of extraction, transport, and disposal of sargassum.[7] In a study on sargassum removal in Mexico, machines were employed to remove massive volumes of sargassum which had accumulated and decomposed on beaches. This action resulted in the compaction of sand, destruction of sea turtle nestings and hatchlings, and beach erosion, as large quantities of sand were removed together with the algal masses.[7]

Thick piles of sargassum can trap seeds, animals, and decaying matter that is left on coastal ecosystems.[10] Sargassum also causes loss to ecosystem species, such as nesting sea turtles, who are unable to lay their eggs in beach dunes because the sargassum obstructs their path. Therefore, the sea turtles are forced to lay their eggs within sargassum which is likely to wash over time.[10] Sea turtles and other surface-breathing animals are not able to breathe if there is a thick layer of sargassum on the surface of the water. A study conducted in Mexico in 2017 found that the accumulation of sargassum can prevent sunlight from reaching coral reefs and seagrass beds, causing long -term damage to the ecosystems.

Figure 4: Sargassum on the Beach [16]

3.4 How Can Sargassum be Used?

Various economic opportunities become available for areas experiencing an unprecedented influx of sargassum.[9] Research has found that areas in the Caribbean are paying an estimated $120 million in total to clean up sargassum from beaches.[15] To offset clean up costs, communities may explore options to transform sargassum into raw material for commercial use.[17] While some places in Mexico often tried to bury their algae to create artificial dunes, the influx of the sargassum over time has left no more places to bury it.[18] Different economic applications of sargassum include soil fertilizer, animal feed, fish food, biomass, wastewater treatment, and nutrients for pharmaceuticals.[15;17;19]

3.4.1 Agricultural Use

Today, animal feed and fertilizer are the most common commercial uses of sargassum.[15] In Mexico, the portion of sargassum that is not disposed of is used in the production of supplemental fertilizers for gardens or golf courses.[18] Through scientific research, it has been found that sargassum has outperformed other inorganic fertilizers for agricultural use.[9] When sargassum is used as an organic nutrient-rich fertilizer, it increases crop yield and also improves overall soil quality.[9] Algae commercial use, in particular, has improved protection against plant diseases and pests, promoted root development, increased fruit yield, and improved water-holding capacity in plants.[9]

In addition, sargassum can also be used for composting by mixing with manure and soil and allowing the salt to wash out.[19] This method can also be used to treat areas on the coast affected by erosion.[9] Other alternative agricultural uses of sargassum include supplementary animal feed for cattle, horses, and sheep.[18] When sargassum is composed of a high carbon-to-nitrogen ratio, it is optimal for the production of biofuels. Alternatively, when this ratio is low, sargassum can be used for fertilizers and animal feed.[15]

Figure 5: Seaweed Fertilizer [24]

3.4.2 Energy Source

There is a growing interest in exploring sargassum as a source of biomass.[15] For example, stakeholders in China are concerned with the lack of sargassum on their coastlines, because they recognize that sargassum is a vital component of their coastal ecosystem and can be used as an effective energy source.[20] New markets and economic opportunities for sargassum need to be explored in order to offset the cost of mitigating the negative externalities of the influx of sargassum.[15] A study completed in 2016 recognized that there is a large economic opportunity in using bio-refineries as a way to create biofuels.[15] Bio-refineries use the combination of bio-based products and energy to produce biomass. This innovative technology can maximize the production of high-value products created from sargassum, including nutraceuticals and vitamins, enhancing the biofuel industry.[15]

Collecting sargassum as a potential source of bioenergy can be a viable source of renewable and sustainable energy.[15] The enormous masses of sargassum can also be used for the production of biogas, such as methane, and can serve as raw material to improve the biochemical industry.[18] Sargassum can also be transformed into forms of biocoal, a biofuel that is produced in the form of briquettes to enhance the quality of fertilizers.[9]

3.4.3 Pharmaceutical Use

Various nutrients, including proteins, peptides, and amino acids from sargassum can aid in the treatment of diabetes, cancer, vascular diseases, and AIDS.[15] One study recognized that sargassum can be used as a food supplement due to its high levels of nutrients that can also provide anti-inflammatory, anti-obesity, anti-tumour, and antioxidant treatments.[21]

Specifically, the Sargassum natans species, which is common in Dominica, has ingredients that can provide pharmaceutical treatment, and contribute to the prevention of several disorders.[15] The Sargassum natans species has a sufficient amount of docosahexaenoic acid that is known to be important for the development of the nervous system, and for the prevention of cardiovascular diseases.[22]

Figure 6: Pulverized Sargassum [23]

3.5 How to Effectively Collect Data?

All research conducted for this Preparedness Plan relied on available existing data. Data is critical for decision making, and can provide individuals with additional information, however the data on Sargassum in the Caribbean is lacking, especially in Dominica. Finding affordable methods to collect high quality data will allow Dominica to make better decisions and assist in managing Sargassum influxes. In a study, focusing on the quality of data collection, the importance of quality data collection aligning with international standards to increase the usability of the data and to reduce inefficiencies was discussed.[25] UWI Cavehill's Center for Resource Management and Environmental (CERMES) focuses on the impacts of sargassum in the Caribbean region. CERMES has designed material related to the three different levels of sargassum. They have also determined some best practices for mitigating the negative impacts of sargassum.

Other research provides information on methods of affordably collecting data with one key case study showing the success of adding questions to existing surveys.[26] The research stated that prior to adding questions, four factors should be considered: length of original survey (preferable for original survey to be short), content of survey (ensure there is no duplication), amount of inputted questions (additional questions should be limited to four), and geographical region (ensure survey areas are appropriate for the topic of the additional questions).[26]

A few articles provided affordable but technology focused option: text and data mining (TDM).[27] This option would require a specialist in Python or R code that would create an online robot to scan Google and key social media platforms for a limited selection of keywords. From researching sargassum, three keywords were prevalent in all resources: beach(es), seaweed, and sargassum.

3.6 What Policies Work?

In Mexico, regulations for removing sargassum in order to protect Natural Protected Areas were published by the federal government. These regulations prohibited the use of machines within the shallow seawater and from the beach.[7] Further, the Government of Mexico financed a local non-governmental organization to set up barriers on beaches to control the influxes in an effort to develop an integrated management strategy.[7] Manual removal of sargassum was not possible in most areas due to its high volume. However, policies enacted in Mexico ensured regulations reduced beach degradation and erosion in several areas.[7] It is important to have designated areas for sargassum removal as seaweed dumping is an issue in Mexico. Due to the lack of enforcement in Mexico, people are discarding sargassum in prohibited areas.[7]

In many countries, the law does not require agencies to remove seaweed since it is not marine debris but is considered a natural part of the ecosystem.[19] A best management practice was to develop a communication plan, to ensure all stakeholders, including the general public, received relevant and reliable information about sargassum influxes and ongoing management efforts.[8] Since sargassum influxes can be attributed to rises in temperatures among other climate-related factors, some countries may opt to address sargassum in their climate change plans and policies.[28]

A common governance response to the influxes of sargassum has been to develop committees to assess the influxes and determine the proper courses of action. A national committee created in Mexico was made up of scientists from various different universities and institutes to share up-to-date knowledge on sargassum.[7] Another committee made up of six working groups was developed to address different issues with sargassum influxes.[7] Similarly, the Galveston Island Park Board of Trustees initiated a Sargassum Policy Committee to gain knowledge of different stakeholder values and scientific research to develop policies around beach management.[10] Initially, the Sargassum Policy Committee created a policy requiring people to rake and hand-pick the beaches every day. However, there was a lack of funding, time, and guidelines to effectively implement this policy. The committee found that the continuing collaboration with affected stakeholders in addition to balancing social, environmental and economic needs was critical to the success of policy decisions.[10] The committee met weekly and biweekly to facilitate participation with various stakeholders. The first study analyzed elevation changes over a period of time on raked and unraked beaches. The second study looked at the effects of sargassum on species, while the last component looked at the collaborative potential of the Sargassum Policy Committee through observations of meetings and surveying members.[10]

In contrast, legislation can be amended to place the burden of seaweed management on public sector agencies. Agencies should collaborate with coastal managers to recognize the benefits of sargassum as a life-giving plant for beaches and species and to address the negative impacts sargassum has on communities.[19] Establishing clear policies about where, when, and how to clean beaches can be a next step for sargassum mitigation in Dominica.[19]

4.0 CONSULTATION

Discussions with the Fisheries Division clarified that the tourism, agriculture, fisheries, and environment sectors are key stakeholders in managing sargassum. The selection of stakeholders was based on discussions with the Fisheries Division, as well as the network available to Resilify Inc.'s Local Specialist, Leslassa. The thirteen individuals contacted belonged to six different sectors: tourism, agriculture, fisheries, academics, environmental management, and sea-freight. The contact information for these stakeholders can be found in **Appendix A**. The consultation, land use maps (**Appendix E**), and analysis of transportation routes support the action of forming a committee, which is discussed in Section 5.2.1 of the Plan.

Table 1: Stakeholder list

Stakeholder Contacts		
No.	Title	Organization
1	Hotelier, Business Owner, Whale Whisperer	Anchorage Hotel
2	Conservation Ecologist	Ministry of Agriculture
3	Lawyer	HMS Chambers
4	Vice President	Organic Farmers
5	Coordinator	U.W.I. Open Campus - Dominica
6	Engineer	C.R.E.A.D.
7	Dominica Representative	O.E.C.S. Development Expert Unit
8	Environmentalist	Consultant
9	Owner	Picard Beach Hotel
10	Fisherman	Entrepreneur
11	Hotel Manager	Rosalie Bay
12	Fisherman	Entrepreneur
13	Senior Secretary	C.F.R.M.
14	Dominica Representative	O.E.C.S. Export Development Unit
15	Member	C.E.R.M.E.S., U.W.I. - Cavehill
16	Member	C.E.R.M.E.S., U.W.I. - Cavehill
17	Professor	C.E.R.M.E.S., U.W.I. - Cavehill

4.1 What did the Stakeholders Say?

The responses from all contacted stakeholders led to three similar conclusions: the annual influx of sargassum is inconsistent in Dominica; the two most significant negative impacts of sargassum are reducing the beach aesthetics and the strong smell, and that sargassum could be economically beneficial to Dominica as a fertilizer. Representatives from the fisheries and the tourism sector agreed that influxes of sargassum are highly inconsistent, however, a lack of data has made it impossible to quantify this inconsistency. Environmentalists and the tourism industry were most inconvenienced by the smell of the sargassum, as it reduced the ability to cleanup beaches as people would become ill from the smell. The tourism sector was excited to use sargassum for landscaping while farmers stated that they needed a fertilizer with phosphorus, an element found in sargassum.

Three comments differed from the majority of consultation feedback. The first comment was a recommendation to trap sargassum at sea and allow it to be its own ecosystem as it attracts different species and can be used as a FAD for fishermen. Secondly, the Fisheries Department stated, as a key impact, that sargassum influxes block their boat landing site causing difficulties in bringing boats ashore and selling their fish. The final differing comment was that sargassum reduces beach erosion as it acts as a protective barrier.

Other general but clarifying findings from the consultations allowed Resilify Inc. to ensure an effective plan is developed for Dominica. As a developing country, Dominica does not have the funding or a designated budget to properly manage sargassum influxes. Dominica also does not currently have the infrastructure designated to properly deal with sargassum influxes. Funding agencies such as the Green Climate Fund and the World Bank could potentially assist. However, developing infrastructure for a sargassum specific industry would be strain on Dominica as maintain current infrastructure is difficult made more challenging by regular hurricanes. Also, stakeholders confirmed that sargassum influxes were inconsistent but normally on the low to moderate amounts landed on Dominican shores. Other islands and countries experience high quantities than Dominica and this could foresee a future of higher influxes.

A key stakeholder is the University of the West Indies (UWI) Cavehill Campus who has created the Center for Resource Management and Environmental Studies (CERMES) and has been active in the management of sargassum in the Caribbean region. CERMES has executed two Sargassum and Future Entreprise (SAFE) Symposiums in 2015 and 2018 to discuss trends and management methods of sargassum. CERMES has also created information bulletins to educate on methods of management based on recent regional studies (Appendix C). Diverse researchers and professors have shared their work at the SAFE Symposiums, providing information on the methods in which sargassum can be used, such as in fertilizer.

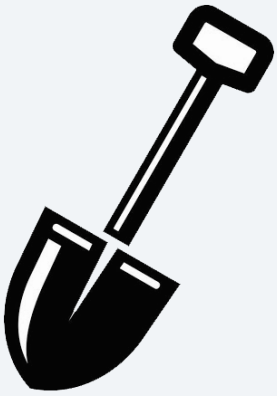
5.0 SHORT AND LONG-TERM STRATEGIES

Strategies have been identified to sustainably mitigate the negative externalities of the influxes of sargassum in the Dominican context, while capitalizing on the benefits of these influxes. While the short-term strategy is cost-effective approach and provides a "quick-fix", the long-term strategy would be considered a more sustainable to be implemented in Dominica.

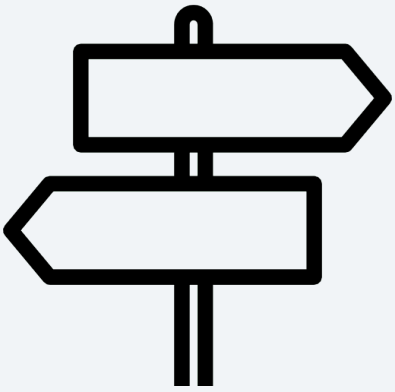
5.1 What to Do Now

As a short-term strategy, Dominica can manage the influx of sargassum by implementing the following three actions as an immediate response.

Rake the sargassum to the back-shore or dunes of the beach.



Bury the sargassum to reduce unattractiveness and smell.



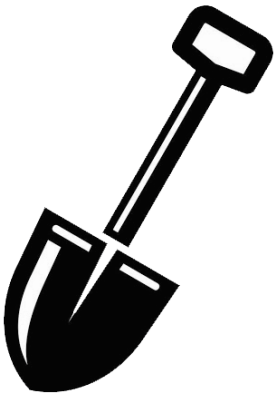
Place signage on popular beaches to inform tourists.

All three responses are cost-effective actions to help mitigate the negative effects of sargassum on the beaches of Dominica today. Through research and consultation, it was found that many people already carry out these actions in Dominica and similar jurisdictions. These actions are short-term responses to sargassum, whereby the long-term strategy later discussed provides more sustainable recommendations moving forward. It is important to note that carrying out these three immediate responses is not a long-term solution for mitigating the influx of sargassum in Dominica. Dominica should consider and begin to implement the long-term strategies identified in Section 5.2 of the Preparedness Plan.

5.1.1 Rake the Sargassum

As sargassum washes up onto Dominica's shoreline, individuals employed under the National Employment Program (NEP) can physically rake the sargassum onto the beach every month. The Fisheries Division will provide monetary compensation to each individual (e.g. fishermen) to coordinate the clean-up of the affected areas. During the clean-up, the sargassum will be relocated to the back-shore or dunes of the beach, creating one pile of sargassum on each beach. This practice will reduce the visibility and unattractiveness of the sargassum on the shoreline. As the sargassum sits further up on the beach, it will eventually dry out over time to reduce the negative smell. Furthermore, the sargassum can then be potentially utilized as a raw material, as explained in Section 5.2 of this Preparedness Plan.

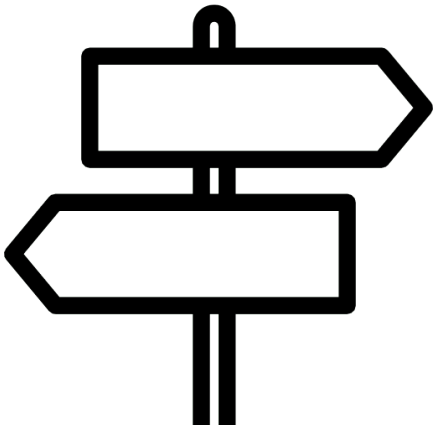
5.1.2 Bury the Sargassum



The second recommendation would be to bury the sargassum on the beaches. Similar to raking the sargassum onto the beach, paid employees of the Fisheries Division would rake the sargassum on the beach and then bury it. Individuals can bury the sargassum into existing or artificial dunes in one area of the affected beach. Burying the sargassum will reduce the unattractiveness and negative smell of the sargassum.

This strategy may potentially benefit the tourism sector. It is important to note that this mitigation strategy should only be implemented when there are small amounts of sargassum on the beaches of Dominica. In the cases where there is a continuous large influx of sargassum, it will become difficult to find the space to bury it.

5.1.3 Implement Signage on the Beaches



It is evident that the influx of sargassum has a negative effect on the attractiveness of the beaches and Dominica's tourism sector. The third recommendation would be to implement signage about sargassum. By placing signage about sargassum on popular beaches, people will become more aware and educated on what sargassum is and what is being done to help mitigate the influxes. Signage can also educate business owners and affected individuals on how to respond to the influxes of sargassum (i.e. rake up or bury the sargassum on the beach). In addition it will help to reduce the negative impacts on the tourism sector through increased awareness of the issue.

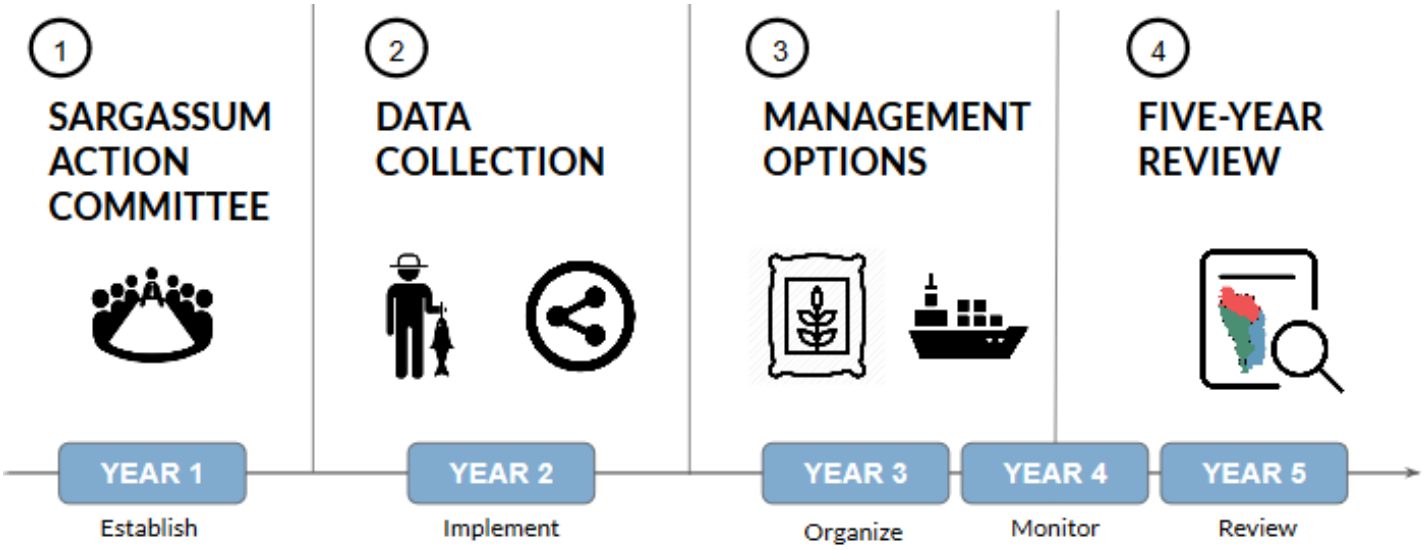
This signage can be created by the proposed committee or involved stakeholders that are educated on the topic. In addition, signage can be made for affected stakeholders, such as owners of beachfront hotels and coastal properties. Examples of sargassum beach signage can be found in Appendix B.

5.2 What to Do Over Time

Table 2: Overview of Long-term Strategy

Title	Description
Sargassum Action Committee	Establish the Sargassum Action Committee to be accountable for the management of sargassum by the end of Year 1.
Data Collection	Utilize existing data collection projects and create an online survey to fill information gaps on sargassum location and quantity by the end of Year 2.
Management Options	Collect, dry, transport, and store sargassum with the intent to sell as fertilizer or export to the Barbados in Year 3 and monitor the program in Year 4.
Five-Year Review	Analyze the Sargassum Action Committee, tracking methods, data collection, and management actions for effectiveness in order to improve the Strategic Sargassum Preparedness Plan for Dominica.

Resilify Inc.'s long-term strategy provides the Fisheries Division with a clear road map to partnering with key stakeholders to manage sargassum influxes in Dominica and to adjust appropriately to future changes. Resilify Inc. provides four best practices.



5.2.1 Sargassum Action Committee

Best management practices from various jurisdictions have proven the effectiveness of utilizing committees, including both private and public sectors, to mitigate sargassum influxes. It is recommended that Dominica form one high-level committee, called the Sargassum Action Committee (SAC), and three sub-committees divided geographically into the North Region, East Region and West Region, as displayed in Figure 7. The SAC will function under the Ministry of Environment, Climate Resilience, Natural Disaster, and Urban Renewal. The Ministry will house the meetings and provide the necessary resources to facilitate the SAC. After discussions with the the Fisheries Division, it was determined that only one fisheries officer is currently responsible for managing sargassum and this was unlikely to increase as there is a lack of human resources currently available. For this reason, only one representative from the Fisheries Division has been included within the committee.

The three subcommittees provide more direct accountability for the challenges faced by the different regions of Dominica. Members from the sub-committees will form the larger high-level committee, as displayed in Figure 8. The public and private sector members were chosen because of their current or potential interest in sargassum in their respective industries. The SAC member positions will be voluntary unpaid positions.

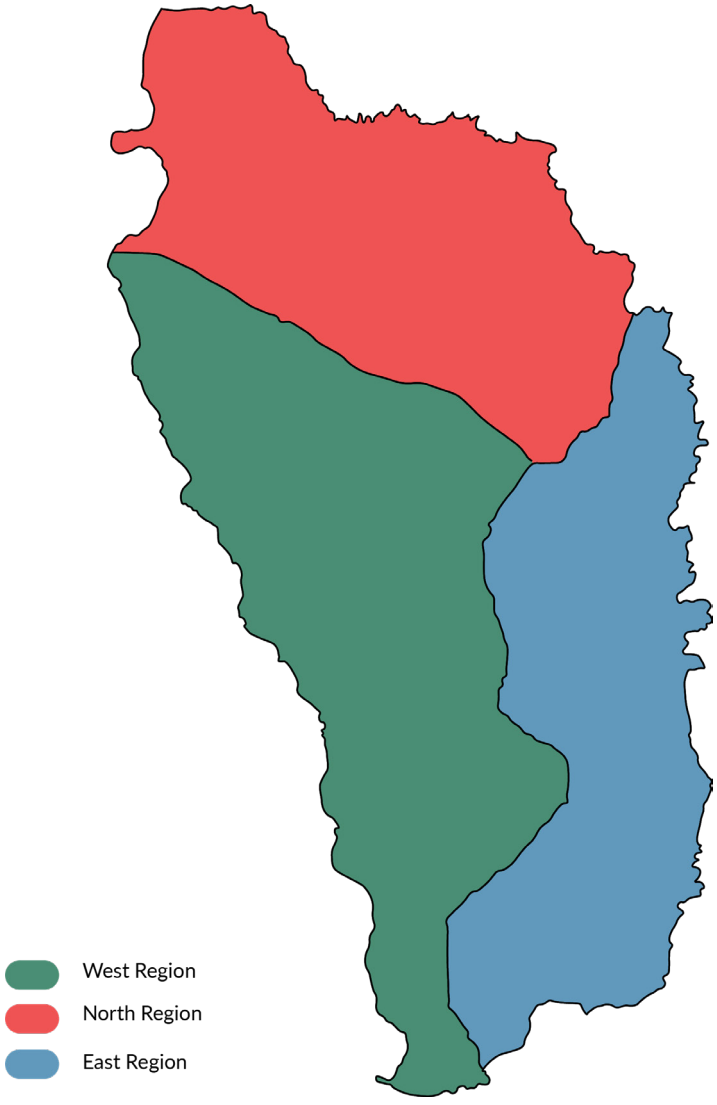


Figure 7: Map of Dominica, Dividing the Country into Three Proposed Regions

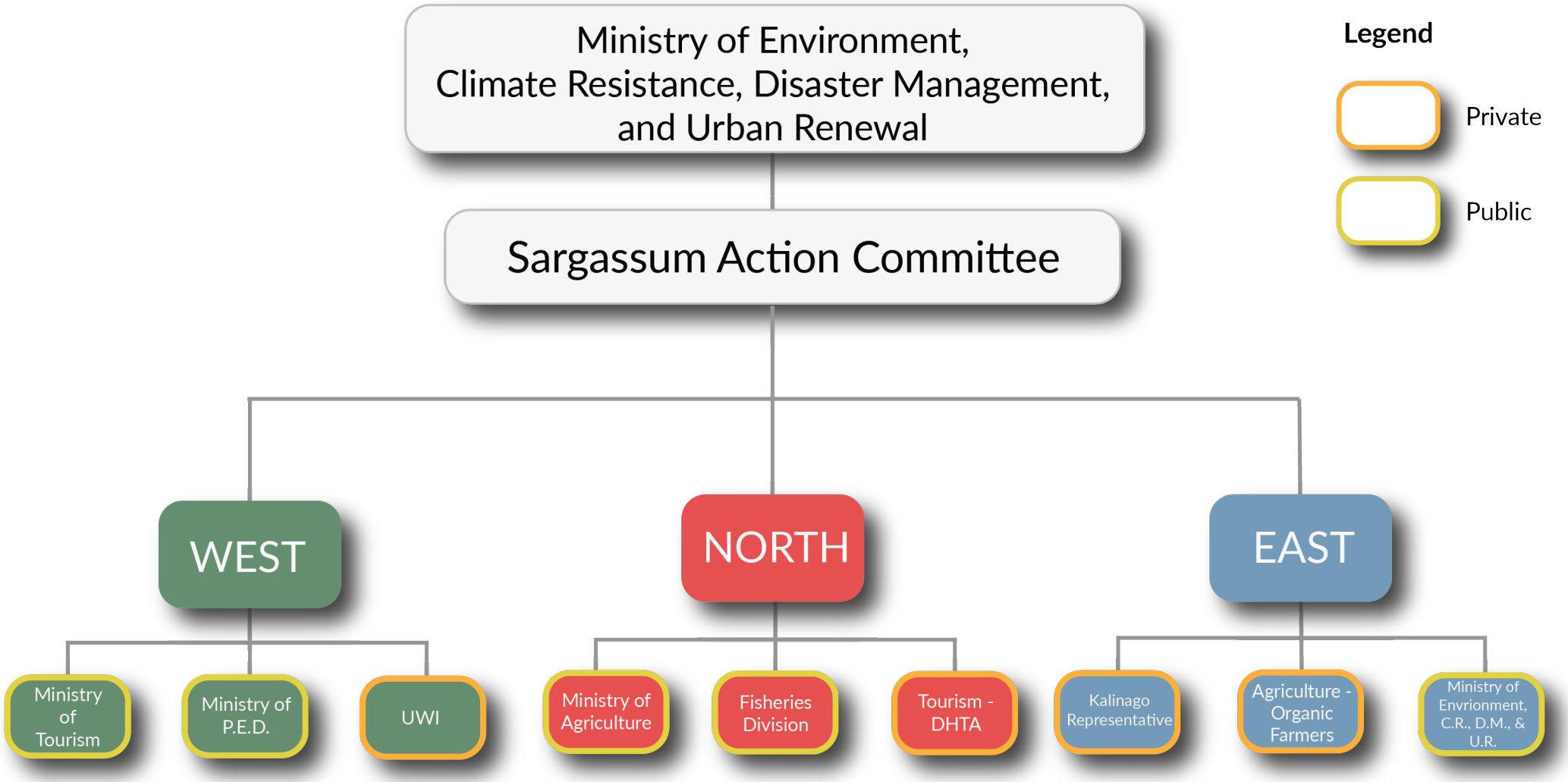


Figure 8: Proposed Sargassum Action Committee Organizational Chart

Table 3: Assigning Stakeholders to Regions

Stakeholder	Region	Reason
Ministry of Tourism	West	The Caribbean Sea is calmer than the Atlantic Ocean, causing the majority of beachfront hotels to be located in the West Region of Dominica. Two new hotels are currently being developed in the West Region.
Ministry of Planning and Economic Development	West	The two main towns of Dominica (Roseau and Portsmouth) are located in the West Region, therefore this zone is the highest economic driver of Dominica.
UWI - Open Campus	West	The UWI campus is located in the capital city, therefore all staff and students are based in this zone.
Ministry of Agriculture	North	The majority of farmers located in the Wesley and Marigot villages. This area is also the safest land in Dominica based on topography (less erosion than steeper lands) and lack of volcanic activity and therefore designated for future agriculture site.
Fisheries Division	North	Marigot Fisheries is the newest and largest fishery in Dominica. It is also a port of entry and therefore it has more available human resources.
Tourism (Private - DHTA)	North	The site of the current and future airport is in the North Region leading to more tourism development in this area.
Ministry of Environment, Climate Resilience, Disaster Management and Urban Renewal	East	Based on Dominica's GIS Composite Hazard map, the East Region has a significant amount of vulnerable lands. It is likely that these organizations will have an interest in this area because of the anticipated increasing natural disasters as a result of climate change.
Kalingo Representative	East	The Kalinago Territory is located in the East Region.
Agriculture (Private - organic farmers)	East	Many of the members of the organic farmers are located in the West and East Regions. However, those in the West Region are located near the regional border and can use the transportation route to easily move to the East Region.

MANDATE

The SAC will be responsible for:

- Identifying gaps in policies with respect to sargassum and informing the Ministry of Environment, Climate Resilience, Natural Disaster, and Urban Renewal;
- Assist in sourcing funding options;
- Providing information and helping to prepare proposals to apply for necessary funding (i.e., through the Green Climate fund or World Bank);
- Addressing problems faced by the sub-committees;
- Ensuring data is being collected regularly and appropriately;
- Overseeing logistics…
    - Consulting the Ministry of Environment, Climate Resilience, Natural Disaster, and Urban Renewal on collection and transportation methods of sargassum;
    - Recommending drying locations of sargassum;
    - Recommending storage locations of sargassum;
- Discussing the progress of action items in each region; and
- Ensure the five-year review is conducted

The sub-committees (North, East and West Regions) will be responsible for:

- Ensuring decisions made by the SAC are carried out;
- Ensuring data is being collected regularly and appropriately;
- Informing the SAC of the levels of sargassum experienced in their region;
- Informing the SAC of the effectiveness of the Preparedness Plan;
- Working with stakeholders at the ground level to understand the unique problems each region faces in addressing sargassum;
- Bringing important contextual evidence and insight into issues faced within their respective region to the SAC; and
- Overseeing drying, collection and transportation of sargassum.

Implementation

The Sargassum Action Committee will meet bi-annually at the Ministry of ECNU to address the above noted responsibilities. Bi-annual meetings allow Committee members to ensure that enough data and insight can be brought to each meeting to make informed decisions. A summary document should follow each meeting and be comprised of the meeting's minutes, action items for sub-committees, general recommendations, and important takeaways. This document should be provided to all members of the SAC. Annually, these bi-annual summary documents should be compiled into a report and reviewed by the SAC to make informed decisions in years to follow.

Resilify Inc. recommends that the North, West, and East sub-committees meet quarterly to address their above-noted responsibilities. During periods where sargassum influxes are more frequent, or more matters must be addressed, it is recommended that sub-committees meet more frequently. It is recommended that committee members meet in person, however, if this is not logistically possible, technological platforms can be utilized for meetings. A summary document should follow each meeting and be comprised of the meeting's minutes, recommendations and important takeaways. This document should be provided to all members of the sub-committee. Key discussion points from the sub-committee summary documents should be presented at each SAC bi-annual meeting. All sub-committee summary documents should be stored with the SAC for better management, and so all information and data can be accessed by all sub-committees.

Considerations

While the SAC is currently a volunteer committee, private sector member positions within the SAC could easily become paid positions overtime. SAC members will have a unique understanding of the sargassum influxes. This may provoke the government to place more responsibilities on on SAC members over time. Private sector stakeholders may not feel they have the time to volunteer for the committee if these responsibilities increase. Introducing paid positions may foster greater participation from private sector members, and ensure they are fulfilling their roles effectively. These private sector member positions could be compensated by the Ministry of ECNU. Public sector members would continue to hold voluntary unpaid positions within the SAC.

5.2.2 Data Collection

The establishment of the first target, the Sargassum Action Committee, will provide a foundation to carry out critical elements of managing sargassum in Dominica. The second target of the Long-term Strategy and a main objective of the SAC is to collect, manage, and track sargassum data. To appropriately manage influxes of sargassum in Dominica, gathering data on the location, quantity, and frequency of sargassum influxes is critical. Without current and consistent data, sargassum trends cannot be fully understood. Hence the importance of the SAC mandate: developing and implementing an effective method for sargassum data collection. Existing data collection software used by different Ministries in Dominica are Open Source Maps and Microsoft Access. As discussed in the findings of this Preparedness Plan, Open Source Maps is recommended as it improves communication between local ministries and private sectors, while allowing alignment with international organization standards.

The sargassum tracking process should aim to be an affordable and sustainable method of data collection that can be easily stored and is immediately usable. The objective of this data collection method is to retrieve usable data. The data collected should allow the SAC to project and estimate the location and quantity of sargassum in Dominica.

Implementation

Each member of the Sargassum Action Committee must be up-to-date with any studies and / or surveys being completed by their division or company. The first step would be to add two to three questions regarding sargassum to any existing study in their sector. Currently, the Fisheries Division is implementing a project to equip all fishermen with devices to record fishing data.

The SAC will ensure that two additional data points are collected by the fishermen:

1. Where did you experience sargassum?
2. How much sargassum did you experience?

This data would include the geographic coordinates of the sargassum and the quantity of sargassum. A three-level scale will be used to describe sargassum quantities, which aligns with CERMES categories:

1- A Little
2- Moderate
3- A Lot

A little

Moderate

A lot

Figure 9: CERMES Divisions of Amount of Sargassum[30;31;32]

Other avenues to conduct this method of data collection in the future would be to join any planning or ecological studies being completed.

All private and public sector stakeholders should implement a short online survey to assess people's reactions to sargassum on the beach. Collecting data via social media would be a complementary process that could fill data gaps. This process would involve a simple survey posted on all stakeholder websites and social media platforms. The survey may look like Appendix F. The following questions could be included on the survey:

1. Where did you experience sargassum?
2. How much sargassum did you experience?
3. What effect did the sargassum have on you?

The responses from the fishermen and the online survey will be combined by the subcommittees quarterly and quality checks would occur. Bi-annually, prior to SAC meetings, the data will be sent to the SAC who will update a master database, which is stored with the Ministry of Environment, Climate Resilience, Disaster Management, and Urban Renewal. A secondary quality check will occur by the SAC. The data must be clean, quality-checked and updated quarterly to ensure the information is usable and beneficial for decision-makers. This quality assurance includes checking for spelling mistakes, removing of empty or unusable entries, aligning location coordinates and location names, and addressing any other irregularities. The SAC will also update the open maps with the most recent sighting of sargassum.

<u>Considerations</u>

The development of Data Mining to improve the quantity and quality of data collected, as well as potentially filling gaps could be very beneficial to Dominica. This strategy would require hiring a specialist to develop the online bot that would scan different platforms for keywords. The suggestions based on keywords found in the literature, which would be regarded as layman terms, are sargassum, seaweed, and beach(es).

5.2.3 Management Options

The following long-term management options will ensure that Dominica is prepared for an increase in the presence of sargassum. These management options should be considered separately from the immediate actions, and form the third target in the long-term strategy for sargassum influxes in Dominica.

Low Influx Action

Dominica, in its current state, is experiencing low and fluctuating levels of sargassum. To effectively manage the current sargassum levels Dominica is experiencing, the government will be responsible for the collection and transportation of the sargassum. The SAC will be responsible for and oversee the entire process. Each month, landscaping employees (usually hired to maintain roadways) will be hired by the government to clean up the beaches and collect the sargassum in one designated area of the shoreline. Each beach will have a designated area where sargassum will be laid out to dry. A map will show which beaches will be cleaned and outline the potential zones for drying. Optimal locations will be selected which would minimize the negative impacts of sargassum on human health and the ecosystem. Once the sargassum is completely dried, it will then be collected and transported to its nearest regional fishery port for storage. Members from the sub-committees will be responsible for transporting the sargassum from their region to their designated fishery ports. The sargassum can then be sold off to local farmers (including organic farmers) to be used as agricultural fertilizer.

High Influx Action

If the influx of sargassum continues to increase over time, a long-term management option would be implemented in Dominica. Once the fishery ports that are storing sargassum reach capacity, sargassum can be exported by ship and sold to Barbados. Barbados already has existing infrastructure to store and convert sargassum into biomass. Sargassum converted into biomass can be used as a renewable energy source in the Caribbean, therefore presenting economic benefits by offsetting Dominica's sargassum clean-up costs.

Considerations

Management practices for sargassum should be considered in the short and long-term for Dominica. The main consideration for determining the best management practice is to identify and analyze the amount of sargassum the area is experiencing. Through additional efforts in data tracking, the Fisheries Division will be able to better understand the consistency and the amount of sargassum the beaches are experiencing. In addition, for long-term management plans, the transportation costs of sargassum will also need to be identified if Dominica decides to export to Barbados. For specific beaches, such as Rosalie Bay and Champaign Beach, high influxes could increase negative impacts. Rosalie Bay is a nesting beach for turtles, and high influxes could detrimentally harm the newborn turtles. Champaign Beach has a large coral reef that could be damaged by decaying sargassum and the deoxygenated process. Additional protective methods should be used at these beaches to potentially stop the seaweed from reaching these areas. Data tracking will also be used to inform management of this option.

5.2.4 Five-Year Review

An important long-term best management practice in environmental planning is regular review. It is recommended that the final target of the Long Term Strategy would be to conduct a five year review of the Preparedness Plan. The first review should commence in 2024 and would be reviewed and updated if necessary in five-year intervals.

In five years, a substantial amount of data should be collected on the sargassum influxes experienced on Dominican beaches, which could be analyzed for insight into this issue. The assumptions made in the development of this Preparedness Plan due to the limited availability of data could be reviewed. Five years also allows for enough time to monitor and evaluate the effectiveness of the strategies and actions put forward by this Preparedness Plan. Additionally, it is expected that additional research on sargassum by other sources, including investigations into the reasons for the influxes and potential applications for sargassum, will have been completed by 2024. The insights collected from this research could also be considered during the review process.

The aforementioned information may be used to determine if the sargassum influxes in Dominica could be addressed more effectively. This analysis could be used to adjust the Preparedness Plan if necessary. The potential to develop additional policy or legislation to support sargassum management could be considered. The structure of existing communication networks and of the SAC proposed in Action No. Two of this Preparedness Plan could also be improved upon if appropriate.

An additional step to be considered during the five-year review is to develop a social media mining program for the data collection of location and amount of sargassum. It is recommended that this review is completed by an environmental consulting firm, such as Resilify Inc. Collaboration with a university could also be beneficial for the review. Prior experience developing environmental plans would be an asset for whichever party is tasked with undertaking the review.

Comprehensive consultation should be undertaken during this review to identify comments and concerns from stakeholders. It would, therefore, be beneficial for stakeholders' contact information to be continuously updated by the SAC in order to carry out this consultation efficiently.

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Cover Page source: Michael Lees

Appendix A, B, C, and E image source: Daelen Fadelle

Appendix D, and F image source: Francois Norris

Appendices

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Appendix A:
Stakeholder Responses

Resilify Inc.

Stakeholder Field	Responses
Tourism	• Sargassum has gotten stuck in the boat's cooling system and blocked it completely or almost completely on a number of occasions, which resulted in having to change an impeller. • Sargassum comes up on the beach at Picard, however, it seems to dry up in days and gets dragged back out to sea on the next choppy day. • Of course, being on the Leeward coast means the problem is much less than on some of the Atlantic Bays, such as Pagua. • There does not seem to be any correlation between the weeds and the whales as whales are seen even on days with lots of sargassum. • We have taken small amounts of sargassum to be added to soils. • I believe that we should be looking into doing more of this agricultural application. • There should be an emphasis on the harvesting and use of sargassum. • Sargassum could create an ecosystem of its own. I have seen flying fish which are yellow to blend in with the weed's colour. Mai Mai are caught in large numbers. • How do we set up a system to use a large mass of sargassum like a FAD and station it somewhere our fishermen can exploit? • The northwest beach of Picard had a lot of seaweed strewn on the beach about two years ago. • I had hoped to harness it for fertilizer for landscaping purposes but the fishy / decaying stench was too strong. I eventually gave in and disposed of it. • In hindsight, I should have buried it for future use. • I should add that there was a small deposit of seaweed on the beach front two weeks ago. • Within three days, the sun had dried this seaweed up, then the sea claimed them back. • To move it off the beach, property owners raked it up, bagged it, and transported it with our hotel garbage men to the garbage site over the deep-water harbour. • As you may know Dominica had suffered from it alot The hospitality industry was greatly affected on the Atlantic side of the island by a massive and persistent arrival of sargassum. Hotels had to close, reimburse their clients. The small tourism stakeholders were the most impacted, tour guides, excursion boats, small restaurants etc. • Tourism in the Caribbean, no matter the efforts of selling green, cultural destinations, is still based on the "postcard imaginary", sea, sand and sun. Not being able to provide this as the seaweed impacts the landscape, is obviously the main challenge. I would add that the recent studies proving that breathing seaweed is dangerous for health, makes it even worse. This is without saying how much it affects wildlife such as sea turtles and fish, therefore affecting tourism professionals trying to develop eco-tourism products as their main selling asset. • This can participate in sustainable tourism advocacy on the importance on environmental protection and raise awareness on that subject, as studies tend to say that while many reasons explain this abnormal influx of sargassum, it may come from climate change and overuse of chemicals. It also represents a challenge that forces tourism stakeholders to reinvent themselves which at the end can end in creative projects.

Stakeholder Field	Responses
Environmentalist	• To my knowledge, the sargassum in Dominica has not directly impacted the wildlife projects that I currently work on so far. However, the potential to do so exists. There have been reports of invasive species hitching a ride on sargassum like the invasive iguana (Iguana iguana) that was found on top a sargassum patch outside of Saint Lucia. Dominica is the last stronghold for the regionally endemic Lesser Antillean Iguana (Iguana delicatissima). Introductions of Iguana iguana to the island could lead to the extinction of this species. • The sargassum piles on the east coast beaches in Dominica has also prevented us from conducting beach cleanups in these areas because of the overpowering smell. Sargassum has also caused an overpowering smell in coastal communities, marine organism deaths, alternative fishing area grounds, and coastal protection. • Sargassum has caused a disruption of social activities, making beaches unpleasant to visit, which could be considered a negative impact on our tourism industry. • Managing sargassum seems to be out of the current capacity in Dominica. • The quantity of Sargassum received during its periodic waves covers a significant amount of the island's coastline, which has caused an unpleasantness in those areas for both sight and smell. • Training is needed to deal with this issue. • Sargassum exists for a reason. It acts as a protective layer for the coastline reducing the potential extent of coastal erosion. • Sargassum is also believed to be a valuable agricultural product (organic fertilizer though further research is needed), as well as providing a fishing ground for our fishermen. • There are a few people from WildDominique's team who would be interested in this project and have some sort of capacity to contribute. • We have experienced organic farmers, an ecologist who has learned of how other Caribbean countries such as Belize and Trinidad tackle the issue, and the challenges they face, as well as members involved in the tourism sector who could act as a knowledge-base for one of Dominica's main industries. • Several islands have turned to remove sargassum along their beaches via heavy machinery. • However, if sargassum is to be removed from a coastal area, an Environmental Impact Assessment needs to be conducted, as some of these influxes occur during sea turtle nesting season, the nests of which would be destroyed if heavy machinery is used. • Groups are working on a floating barrier to prevent the sargassum from coming onshore. • A community-based sea turtle group in Trinidad (Nature Seekers) leaves some sargassum behind in piles to act as a wave breaker. By piling the sargassum, sea turtles are able to safely find a nesting spoke and hatchlings the water. • Too much sargassum in the sand alters the temperature of the soil (a key factor in the egg's development) and can deter a female sea turtle from laying eggs.

Stakeholder Field	Responses
Fisheries	• When the sargassum is in the ocean, it is not always an issue. Problems arise is when the sargassum is spread out near a F.A.D. (fish aggregating device) and prevents you from catching. • When it is on shore, that is when sargassum causes the most damage. It gathers on the sea shore and smothers all living matter. When it decays, the smell is terrible, affecting the air. Also, if there is a large amount, the sargassum affects the smell of the water and harms species near the shoreline in the water. • The sargassum floating in the sea can be beneficial as it attracts different fish such as dolphin, carwan, and triggerfish. The main issue is when sargassum reaches the shore. • No fishermen have tried to manage the sargassum by themselves. • The amount of sargassum fishermen experience is substantial and would be very difficult to manage on their own. • Fishermen would be able to provide information on the location of sargassum, how much is there, and how fast it is moving. • Maybe later on, if a plan is implemented to remove the sargassum, we can help using our boats. • Sargassum attracts some types of fish, which could allow fishermen to catch more diverse catch.
CREAD	• CREAD will only get involved if it has a climate resilience impact related to socio-economic or infrastructure. At this stage, I do not see it but cannot speak for the organization. Sargassum is not affecting work. • However, in Pagua Bay, and the river mouth, in particular, sargassum clogs the river mouth and makes the conditions swampy / stagnant, causing decay and odours. Sargassum often impedes and prevents access to the beach. It is also an eyesore. • No attempt to manage sargassum influxes has been attempted so far. • Sargassum could be potentially used as fertilizer if properly processed (i.e., salt flushed out and composted). I also understand it is either edible or can be used as a tea. • CREAD could be useful on a committee to see whether composting or other use makes sense, perhaps from an organic farming perspective. • I have no additional comments, other than we do need to determine environmental impacts of the sargassum influxes and cost / weigh against the feasibility of alternate uses / strategies. • I do not have specific insight on this matter as I have not heard alternative uses / strategies discussed at all as a part of CREAD, nor in my previous water sector experience. The only time we experienced the sargassum influxes in the Bahamas was in a hurricane. • If I recall, the sargassum was extracted from the bay and stockpiled, then used for compost. • Also, I do not think the sargassum influxes can be stopped – they may only be mitigated but even that I doubt (especially from a national perspective).

Stakeholder Field	Responses
Lawyer	• The fishermen actually look for mats of sargassum at sea, as many fish, especially Dowad, feed under it. • Farmers are using sargassum as a fertilizer. The main issue is to wash the sargassum very well prior to use. • The fact is that there has been much less sargassum in the last year. It was very prevalent last January to May, however, there is not as much sargassum this year. • In fact, comments I have heard is that there is a net benefit from it. • I can tell you that there is no law covering the sargassum grass
Agriculture	• The Organic Farmers are in the researching stages to ensure sargassum does not harm soils. • We know for a fact that sargassum can be used as a fertilizer, as it has a lot of beneficial micro and macro nutrients, especially phosphorus which is an element we farmers struggle to obtain in nature sometimes. • We know that sargassum has certain levels of arsenic, which could be harmful to plants if we do not prepare it properly through i.e., washing or composting. • It could be a real blessing to develop a proper processing method and have community-based commercial composting facilities to produce low-cost high-quality organic compost fertilizers for our farmers. • We are awaiting tests on the sargassum to find out exact the chemical composition and determine if any potentially harmful chemical compounds and or radiation from possibly Fukushima radiation from Japan exist. • We would be interested in working with the proposed sargassum committee. • The best way to handle this sargassum is to harvest it, compost it and use it in agriculture. • Another great idea is to create biogas with it. I know sargassum has great biogas potential. • We should look into opening biogas plants along the coastline. DOAM is working toward these goals

Appendix B:
Example of Beach Signage [33]

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SARGASSUM

Winds, storms, spiraling currents disperse Sargassum throughout the world's oceans

Nursery for 3 Species

Macroalgae (Seaweed)

Warms Surface Waters

A Floating Jungle

127 Species of Fish

145 Invertebrate Species

10 Endemic Species

Appendix C:
CERMES Information Page [34]

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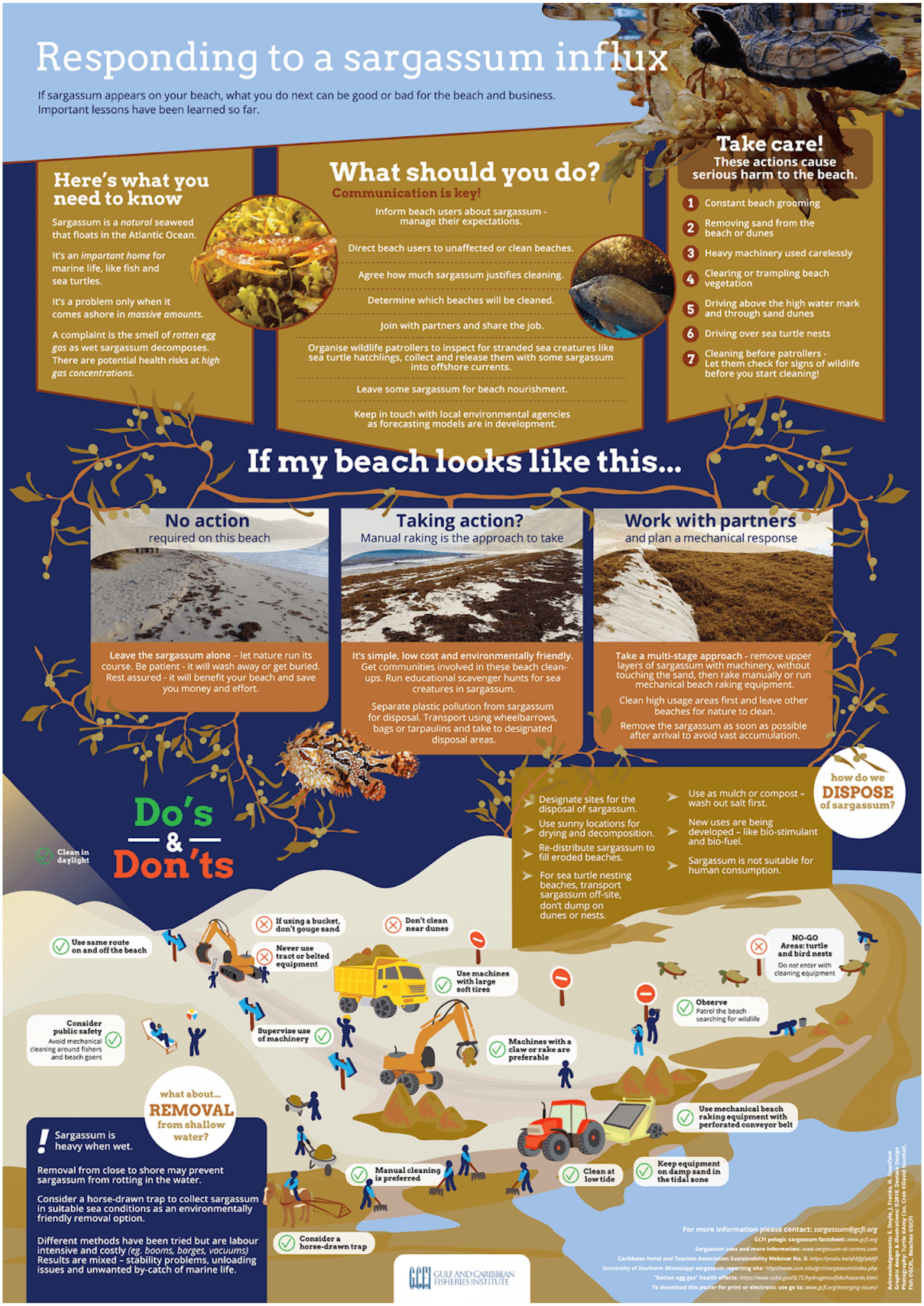
Responding to a sargassum influx
If sargassum appears on your beach, what you do next can be good or bad for the beach and business. Important lessons have been learned so far.
Here's what you need to know
Sargassum is a natural seaweed that floats in the Atlantic Ocean.
It's an important home for marine life, like fish and sea turtles.
It's a problem only when it comes ashore in massive amounts.
A complaint is the smell of rotten egg gas as wet sargassum decomposes. There are potential health risks at high gas concentrations.
What should you do?
Communication is key!
Inform beach users about sargassum - manage their expectations.
Direct beach users to unaffected or clean beaches.
Agree how much sargassum justifies cleaning.
Determine which beaches will be cleaned.
Join with partners and share the job.
Organise wildlife patrollers to inspect for stranded sea creatures like sea turtle hatchlings, collect and release them with some sargassum into offshore currents.
Leave some sargassum for beach nourishment.
Keep in touch with local environmental agencies as forecasting models are in development.
Take care!
These actions cause serious harm to the beach.
1 Constant beach grooming
2 Removing sand from the beach or dunes
3 Heavy machinery used carelessly
4 Clearing or trampling beach vegetation
5 Driving above the high water mark and through sand dunes
6 Driving over sea turtle nests
7 Cleaning before patrollers - Let them check for signs of wildlife before you start cleaning!
If my beach looks like this...
No action
required on this beach
Leave the sargassum alone – let nature run its course. Be patient - it will wash away or get buried. Rest assured - it will benefit your beach and save you money and effort.
Taking action?
Manual raking is the approach to take
It's simple, low cost and environmentally friendly. Get communities involved in these beach clean-ups. Run educational scavenger hunts for sea creatures in sargassum.
Separate plastic pollution from sargassum for disposal. Transport using wheelbarrows, bags or tarpaulins and take to designated disposal areas.
Work with partners
and plan a mechanical response
Take a multi-stage approach - remove upper layers of sargassum with machinery, without touching the sand, then rake manually or run mechanical beach raking equipment.
Clean high usage areas first and leave other beaches for nature to clean.
Remove the sargassum as soon as possible after arrival to avoid vast accumulation.
how do we DISPOSE of sargassum?
Designate sites for the disposal of sargassum.
Use sunny locations for drying and decomposition.
Re-distribute sargassum to fill eroded beaches.
For sea turtle nesting beaches, transport sargassum off-site, don't dump on dunes or nests.
Use as mulch or compost - wash out salt first.
New uses are being developed – like bio-stimulant and bio-fuel.
Sargassum is not suitable for human consumption.
Do's & Don'ts
Clean in daylight
Use same route on and off the beach
If using a bucket, don't gouge sand
Never use tract or belted equipment
Don't clean near dunes
Use machines with large soft tires
NO-GO Areas: turtle and bird nests
Do not enter with cleaning equipment
Observe
Patrol the beach searching for wildlife
Consider public safety
Avoid mechanical cleaning around fishers and beach goers
Supervise use of machinery
Machines with a claw or rake are preferable
Use mechanical beach raking equipment with perforated conveyor belt
Manual cleaning is preferred
Clean at low tide
Keep equipment on damp sand in the tidal zone
Consider a horse-drawn trap
what about... REMOVAL from shallow water?
Sargassum is heavy when wet.
Removal from close to shore may prevent sargassum from rotting in the water.
Consider a horse-drawn trap to collect sargassum in suitable sea conditions as an environmentally friendly removal option.
Different methods have been tried but are labour intensive and costly (eg. booms, barges, vacuums) Results are mixed - stability problems, unloading issues and unwanted by-catch of marine life.
GCFI GULF AND CARIBBEAN FISHERIES INSTITUTE
For more information please contact: sargassum@gcfi.org
GCFI pelagic sargassum factsheet: www.gcfi.org
Sargassum uses and more information: www.sargassum-at-cermes.com
Caribbean Hotel and Tourism Association Sustainability Webinar No. 5: https://youtu.be/ghkfgEpklfI
University of Southern Mississippi sargassum reporting site: http://www.usm.edu/gcrl/sargassum/index.php
"Rotten egg gas" health effects: https://www.osha.gov/SLTC/hydrogensulfide/hazards.html
To download this poster for print or electronic use go to: www.gcfi.org/emerging-issues/
Acknowledgements: E. Doyle, J. Franks, H. Oxenford
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Appendix D: Map of the Regional Movement of Sargassum [35]

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UNITED
STATES
Gulf Stream
NORTH ATLANTIC
OCEAN
Bermuda
Sargasso Sea
Miami
Key
West
TROPIC OF CANCER
CUBA
Caribbean Sea
STATUTE MILES AT 30° NORTH

Appendix E:
Land Use and Hazard Maps of Dominica [36]

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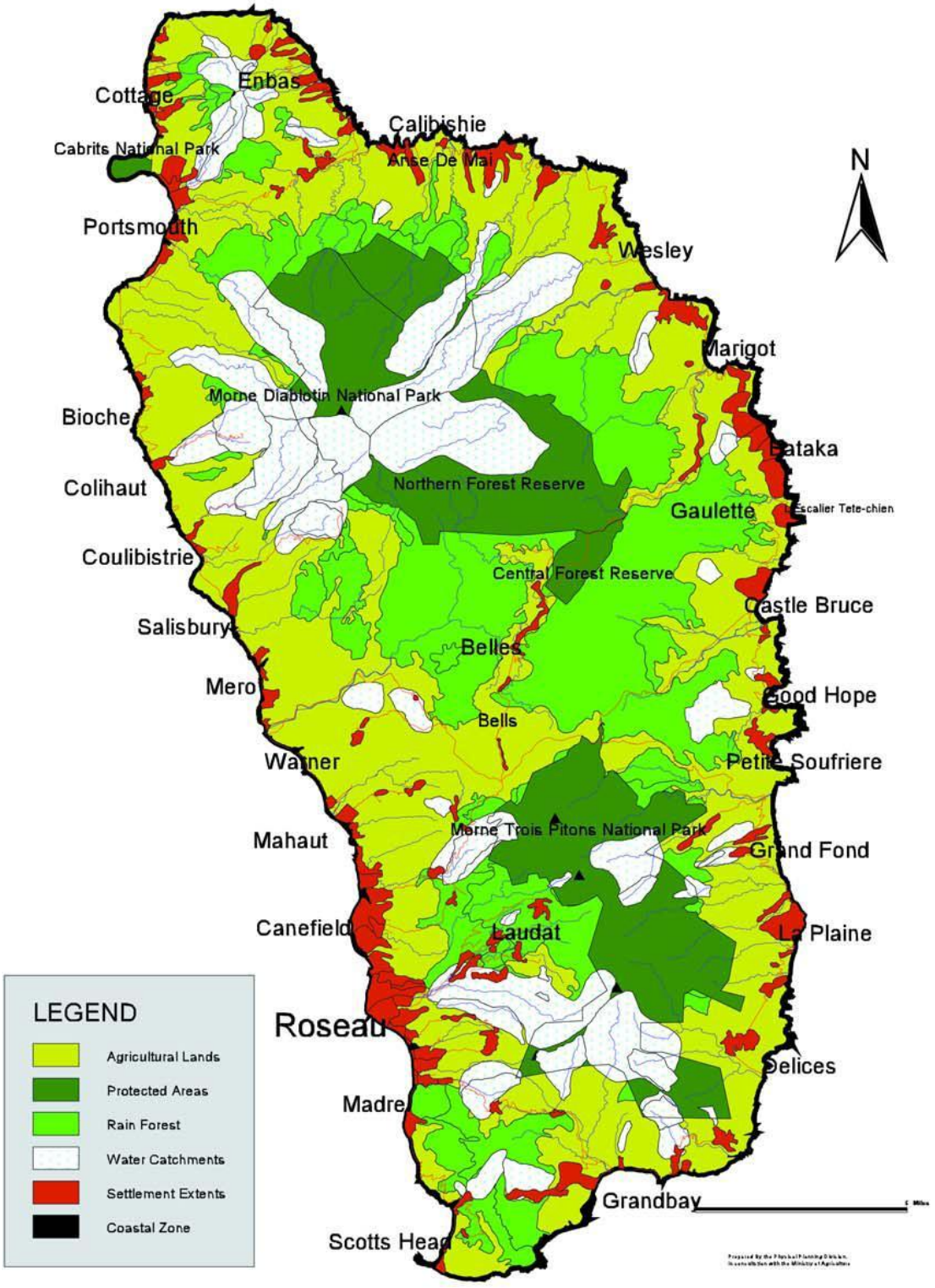

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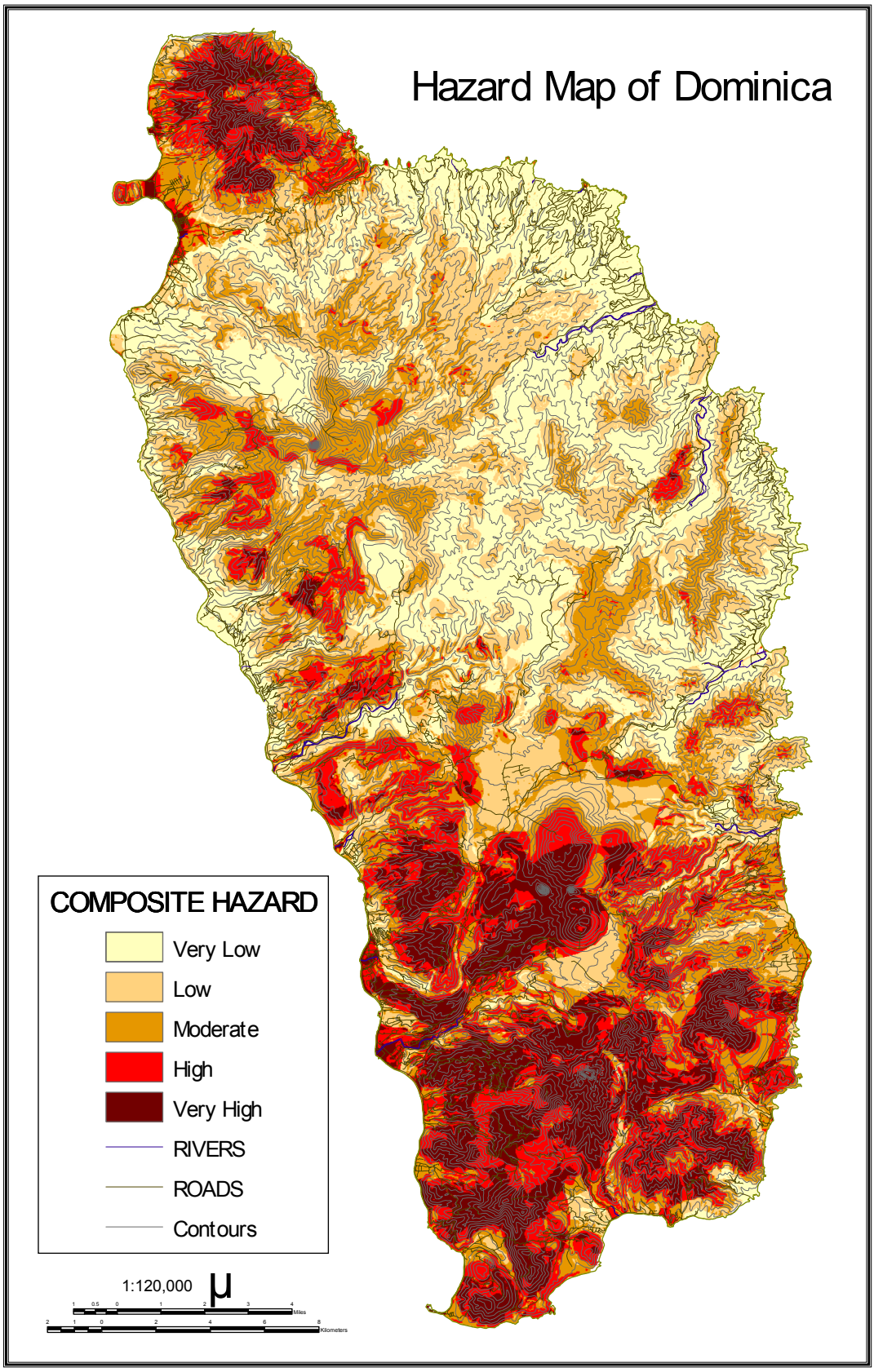
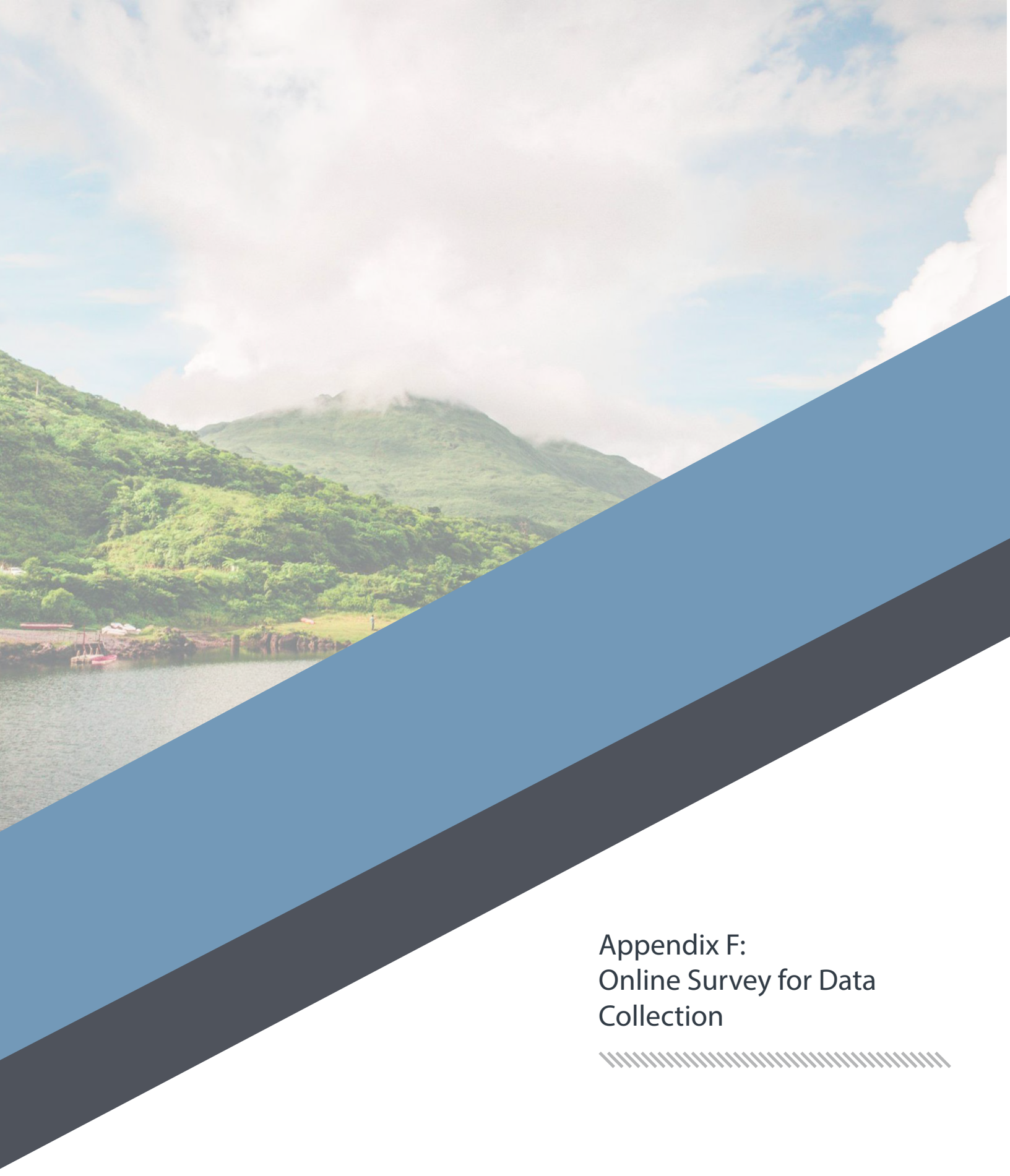

Hazard Map of Dominica
COMPOSITE HAZARD
Very Low
Low
Moderate
High
Very High
RIVERS
ROADS
Contours
1:120,000
Miles
Kilometers



Appendix F: Online Survey for Data Collection

Resilify Inc.

Did you see any brown seaweed (called sargassum) today?

If you saw brown seaweed today, please complete the three questions below. We are eager to know about your experience.

* Required

Where did you see the brown seaweed (sargassum)? *

Your answer

How much seaweed (sargassum) did you see? *

- A little bit of sargassum

- A moderate amount of sargassum

- A lot of sargassum

How do you feel about the seaweed (sargassum)? *

- It is ugly
- It smells
- I did not bother me
- It was interesting

SUBMIT

Never submit passwords through Google Forms.