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**Framing environmental change  
and adaptation governance:  
The case of Sargassum seaweed in  
the Caribbean**

MSc Thesis

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Date: April 12, 2021



I hereby declare that this thesis is fully my own and autonomous work. All sources and aids used have been indicated as such. All texts either quoted directly or paraphrased have been indicated by in-text citations. This work has not been submitted to any other examination authority. The report does not represent the position of Wageningen University on any matters.

Arnhem, Netherlands, April 2021

Eunice Semeleer



Figure 1. Illustration by Fuller, J. (2019). Sargassum certainty.

## Executive Summary

The Caribbean region, popular for its white beaches and crystal-clear waters is a well-known vacation paradise for countless tourists from all over the world. Recently, this region has been battling a new environmental phenomenon that turns its blue waters brown and covers its white beaches with mounts of seaweed: Sargassum. Since the year 2011, unusual amounts of Sargassum mats have been making their way from the Atlantic Ocean into the Caribbean Sea, covering numerous beaches of Caribbean countries. Massive amounts of Sargassum have been observed on the coasts of the US State of Florida, The Gulf of Mexico, the Caribbean Sea, all the way down to the coasts of Guyana in the South. Coastal industries, governments, locals, and tourists have witnessed how the unexpected massive influx of Sargassum mats have put a halt to several coastal activities and, moreover, have impacted coastal ecosystems.

A few years now down the line, this research aims at understanding how different Caribbean countries have been interpreting the environmental change and how they have been translating this understanding into functional adaptation mechanisms. This research looks through the lens of framing theory to apprehend how Sargassum has been understood and furthermore analyze if framing of the Sargassum phenomenon is aligned with adaptation actions. This thesis embarks on a comparative case-study between three Caribbean countries: the Dominican Republic, Mexico, and Trinidad & Tobago. The methods are based on analysis of communicated online news articles for the three years that the Sargassum influx has been the most aggressive in the region along with the contents of adaptation documents of the case-studies.

The main conclusions for this study highlight the importance of contextual characteristics i.e., (i) key economic industries and stakeholders, (ii) availability of financial funds, (iii) and communities most affected, as indicative for principal actions taken towards what is understood as adaptive actions. Furthermore, analysis of framing of Sargassum has shown that the large degree of uncertainty around the phenomenon e.g., its continuity and causation, have functioned as barriers to innovation and out-of-the-box thinking in the case-studies. The study findings contribute to the literature on framing theory concerning the complicated topic of environmental change in highly vulnerable countries.

## Preface

This thesis functions as the final component of my MSc Environmental Sciences at Wageningen University. The process has been extensive and many times challenging, yet also extremely educative and rewarding. I would like to hereby take the chance to thank those who have been along for the journey.

First, I'd like to thank Machiel Lamers, my thesis supervisor, for the time we have spent discussing this topic, the approach and the contents of this thesis, and for the motivation to always take my work a step further. Taking into consideration the global factors that were at play during the development of this thesis, we made it work, nonetheless.

Furthermore, I would also like to extend my gratitude to the UNEP Caribbean Environment Programme organization for the opportunity that I was granted to dive into the subject of Sargassum while I was working as an intern there. This experience has really paved the way regarding my knowledge on the subject, as well as facilitated contacts that were relevant for this study.

Last, but not least, I would like to thank my family and friends for their unconditional support, motivating words, and love along this journey. Their support will forever be appreciated.

I'm happy to present this work on a very important topic at the moment for the Caribbean region. I hope you enjoy reading this thesis and that it can be of use to anyone who is interested.

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*“Everything natural, every flower or tree, and every animal have important lessons to teach us if we would only stop, look, and listen.”*

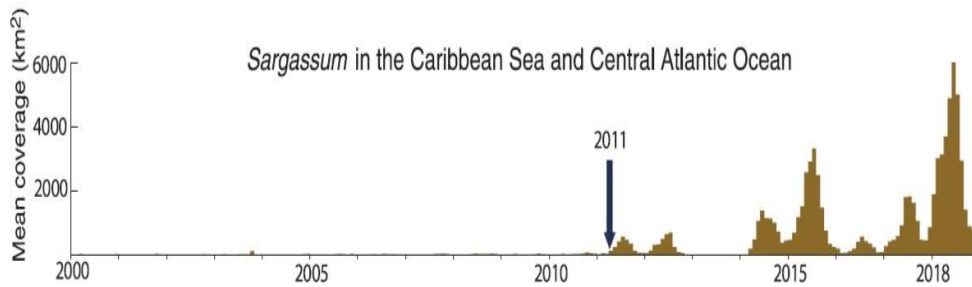
- Eckhart Tolle

# 1. Introduction

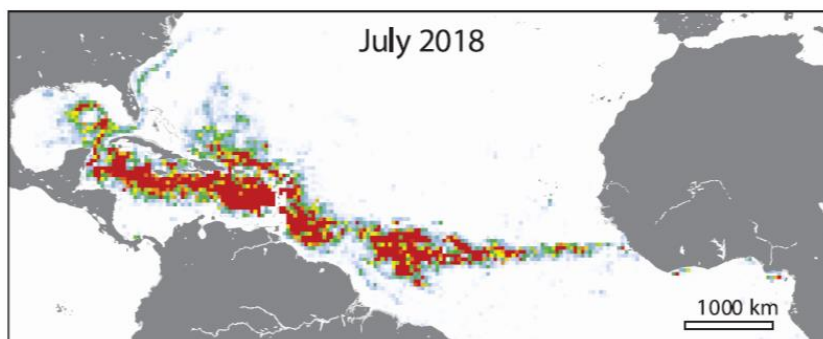
This chapter will introduce the topic of this study by firstly elaborating on the topic’s background and description of the problem. Secondly, what is known in the literature on Sargassum i.e., the state of knowledge will be presented. Hereafter, the research objective and questions that will guide this study will be discussed. Lastly, the thesis outline will be presented.

## 1.1 Background & problem description

In the year 2011 the Wider Caribbean Region (WCR) experienced an unusual large influx of pelagic Sargassum (species *S.fluitans* and *S.natans*). The unprecedented quantity of floating Sargassum made its way into the Caribbean Sea and washed up on numerous coasts and beaches in massive quantities (Gower, Young, & King, 2013). Since 2011, not only has Sargassum influx into the WCR become a recurring annual event (except for 2013), it has since also increased in magnitude (See Figure 2). The influx, which is now labeled as the Great Atlantic Sargassum Belt (GASB), is witnessed from satellite images to stretch from West Africa to the Caribbean Sea into the Gulf of Mexico (See Figure 3; Wang et al., 2019).



**Figure 2.** Monthly mean coverage of Sargassum with a maximum in 2018 of >20 million tons (Wang et al., 2019)



**Figure 3.** Great Atlantic Sargassum Belt: Mean Sargassum coverage for month July 2018 (Wang et al., 2019)

Pelagic Sargassum is a free-floating seaweed found in the Atlantic Ocean characterized by its golden-brown color (Doyle & Franks, 2015). The seaweed's tiny gas-filled bladders allow it to float and reproduce at the ocean's surface; non-attached to the ocean floor (Laffoley et al., 2011). Before 2011, Sargassum was mainly known as the seaweed that makes up the Sargasso Sea – a biodiversity hotspot – located in the subtropical North Atlantic Ocean (Wang et al., 2019). Sargassum is known to grow in open waters and provides, therefore, a unique and important habitat for many species far away from any mainland (Laffoley et al., 2011).

In open seas Sargassum mats provide great ecologic benefits to seabirds and marine life (Mendez-Tejeda & Rosado Jiménez, 2019). Doyle & Franks (2015) highlight in more detail the ecological importance of Sargassum mats:

Sargassum provides refuge for migratory species and essential habitat for some 120 species of fish and more than 120 species of invertebrates. It's an important nursery habitat that provides shelter and food for endangered species such as sea turtles and for commercially important species of fish such as tunas (Doyle & Franks, 2015, p.1).

Furthermore, Sargassum can be beneficial when it reaches coasts in small amounts and provides shoreline stability and beach nourishment (Doyle & Franks, 2015). Recent literature has established that, when in the open sea, Sargassum functions as a bioremediation and absorbs CO<sup>2</sup> from the atmosphere, as much as an average of 19.3 million tons from 2011 to 2019, making it a significant natural carbon sink (Gouvêa et al., 2020; Paraguay-Delgado et al., 2020).

On the other end, challenges arise when Sargassum mats reach coasts and beaches in massive quantities and become a nuisance as it starts to decompose, emitting a foul odor and attracting insects. Additionally, marine fauna can be impacted and suffocated by decomposing Sargassum, causing the death of several marine lives that end up washing ashore. Besides, coastal industries like the tourism and fisheries sector throughout the Caribbean suffer from related economic loss due to a drop in tourists and sea accessibility. In addition, there are the costs of Sargassum clean-up from beaches by the private sector and/or governments. Moreover, typical months for Sargassum presence have been noted to be from May to September – crucial months for the tourism industry as well. To date, the blooming events of 2015 and 2018 have been the most severe ecologically and economically recorded (Mendez-Tejeda & Rosado Jiménez, 2019).

The causes for the recent Sargassum phenomenon are gradually starting to be understood by the scientific community. Nonetheless, as environmental and socio-economic impacts accumulate, it has become a

regional call for action on how to govern the complex issue. Certainly, considering the characteristics and impacts of the recent phenomenon, the situation cannot be taken lightly: “the unpredictable timing, frequency, extent and severity of massive sargassum influxes constitute a natural hazard with potential for disaster” (Cox, Oxenford & McConney, 2019, p. ii). Moreover, since a recent study stated that the unusual Sargassum quantity in the WCR might become the new normal (Wang et al., 2019), this certainly raises questions concerning how the WCR countries plan to adapt to the new situation in the near future.

There has been recently an increase in regional intergovernmental meetings as concern for adaptive capacity increases amongst “coastal and marine state, non-state and private sector stakeholders” (Cox et al., 2019, p. ii). Especially the tourism and fisheries sector, local governments and resorts alike have been struggling to cope with the intensity of the recurring Sargassum (Karetnick, 2019). Cox et al., (2019) have described the situation as follows: “The extent of the influxes (in time, area and volume) and their wide-ranging impacts, were so unexpected that science and management are currently lagging behind” (p. 2). Hence, since Sargassum is far from being fully understood there is high uncertainty on how to respond and adapt to these new normal environmental conditions.

It is certainly a challenge for policy makers to understand and respond effectively when an issue is considered of a ‘wicked’ aspect – as climate change, a key example, has shown (Head, 2014). Wicked problems are characterized as having “overlapping causes as well as consequences in economic, ecological, ethical, and technological realms” (Peters, 2018, p.428) for which there are no simple solutions. Certainly, Sargassum encompasses characteristics that are considered to be wicked: an issue that is massive, difficult to address, imposes a systemic challenge, and the uncertainties around the problem make it hard to define or foresee viable solutions (Lehtonen, Salonen, Cantell, & Riuttanen, 2018; Incropera, 2015). As Head (2014) states: “Where the threats or challenges are novel and uncertain, and where the risks and impacts are not fully understood, effective solutions are difficult to define” (p.673). Consequently, the uncertainties around the phenomenon have created space for several different interpretations and understandings surrounding the topic.

According to Cramer (2008), the frames surrounding a given subject have shown to have implications on the manner in which adaptive actions and policies develop. Therefore, understanding how Sargassum is framed could help indicate and explain how adaptation to the novel and uncertain Sargassum is governed and related policies have come to exist. This research problem is highly relevant at the moment considering that the analysis of this link could help countries from the WCR better cope and align adaptive solutions to the new prevailing situation.

## 1.2 State of Knowledge on Sargassum

The recent Sargassum troubles in the WCR have manifested into a phenomenon that consists of many scientific uncertainties. Hence the literature on Sargassum has analyzed the phenomenon from multiple angles. Many studies have tried to define the conditions enabling the massive blooms, while a handful of articles have aimed to uncover the composition of the seaweed, whereas others have tried to efficiently track the Sargassum mats along their journey; from origin to washing ashore.

So far there is no common agreement on the source region of the massive mats. Some scholars consider the Sargasso Sea the main source area (Mendez-Tejeda & Rosado Jiménez, 2019), while others claim that a new source region has emerged in the tropical North Atlantic (Franks, Johnson, Ko, Johnson, & Ko, 2016; Gower et al., 2013). The most recent study by Johns et al., (2020) supports the hypothesis that changes in wind from the North Atlantic Oscillation (NAO) during winter of 2009-2010 were responsible for unusual dispersal of the Sargasso Sea, causing Sargassum to flow far into the eastern Atlantic and eventually land into the central tropical Atlantic. As consequence, “Sargassum has now a resident population in the central tropical Atlantic” and is reinforced by uptake of several nutrient-rich hot-spots along its journey into the Caribbean (Johns et al., 2020, p.22).

Other studies on Sargassum have focused on the contribution of climatic oceanographic factors to the blooms i.e., ocean currents and the Sargassum route into the WCR (Mendez-Tejeda & Rosado Jiménez, 2019). Studies have also devoted attention to the growth rate and movements of Sargassum into and out of the North Equatorial Recirculation Region (NERR, Franks et al., 2016), and even the influence of nutrient rich waters on the growth rate of Sargassum mats (Lapointe, West, Sutton & Hu, 2014).

The role of climate change in relation to Sargassum has also been considered. Accordingly, there are multiple onset causes that have been considered that could directly or indirectly relate Sargassum to climate change. These causes include a combination of changing sea surface temperatures (SST), wind patterns, ocean currents, precipitation patterns, and African Sahara dust input (Doyle & Franks, 2015; Mendez-Tejeda & Rosado Jiménez, 2019; Wang & Hu, 2016). Furthermore, another factor suspected to have an influence is higher nutrient supply attributed to the West African upwelling and from the Amazon River discharge (Wang et al., 2019). Yet, these are all theories aiming to explain how the blooms have come about, but no definite cause(s) have been established. As Wang & Hu (2016) confirm: “it is extremely difficult to pinpoint the exact reasons for a large-scale oceanic phenomenon” (p. 363).

Meanwhile, other scholars have focused on helping anticipate Sargassum landings through blooming predictions i.e., the observation of Sargassum presence and its quantification as it moves throughout the Atlantic with the use of remote sensing technologies (Wang & Hu, 2016). There is also Sargassum tracking in the form of an early-warning system for governments since early detection can help coordinate networks, effective response and action (Maréchal, Hellio, & Hu, 2017). Lastly, Sargassum's composition for potential commercial uses has also been studied. For example, Milledge & Harvey (2016) studied the possibilities of exploiting Sargassum for food, fuel, fertilizer and pharmaceuticals through the analysis of the algae's chemical composition and presence of marine pollutants.

In sum, the literature on Sargassum is diverse and perplexing. Furthermore, many uncertainties around the unprecedented phenomenon such as, the source region, who to blame and how to solve it, its continuation, the seaweed's organic and inorganic contents and thus usefulness as input for alternative uses, how best to approach its clean-up, and how to lessen the burden on the coastal industries, have created many frames surrounding the topic. The many diverse frames have in turn influenced the application of adaptive measures. Therefore, the unexplored topic in the literature on Sargassum is that of the role of framing. More specifically, the role of framing environmental problem Sargassum and how this aligns with adaptation practices has not been studied. Because countries in the WCR have been affected differently, it makes an interesting case to study how context and Sargassum frames align with adaptation governance.

### 1.3 Research objective and questions

The objective of this study is to first of all understand the relation between framing of environmental issue Sargassum and adaptative actions taken towards the phenomenon. The importance of this relationship is highlighted by Cox et al., (2019) who discuss the connection between understanding and adaptation: "The severity of these impacts, and how stakeholders are, or could be, coping and adapting, needs to be much better understood to inform long-term interventions" (p.2).

The objective will be addressed by looking at the alignment of framing of situational context and Sargassum in relation to adaptive actions and policy taken at the local and/or national level. Situational context is taken into account since it influences how Sargassum is perceived. This thesis intends to explore how the Caribbean region has been coping with this phenomenon, yet the Caribbean region consists of many countries that have been affected differently. Although many countries in the Caribbean region share common characteristics like for example being tourism driven, they differentiate on other terms i.e., the degree of coastal

development and economic importance of coastal activities. Furthermore, not all countries in the region have received the same amounts of influx. Accordingly, many different contextual factors influence how Sargassum can be framed in the specific country and respectively how adaptation takes form. By analyzing three case-studies that differentiate on the contextual level, a more representative analysis can be presented that has considered different contextual factors. Lastly, by understanding the alignment between context, Sargassum and adaptation framing per case, could help form recommendations that support proactive adaptation policies in the future.

The main research question of this thesis is adapted from Harrould-Kolieb (2020) who argued that the framing of ocean acidification (the environmental problem) by the ocean acidification epistemic community affected action taking at the international level. The main research question is formulated as:

*How is Sargassum influx framed in different Caribbean countries and how do these frames align with adaptive solutions?*

The main research question can be divided into three distinct parts: (i) frame analysis of the situational context, Sargassum, and adaptation; (ii) evaluation of the alignment between framing and solution approach; and (iii) comparison between the results of the case-studies. These are respectively formulated in sub-questions:

- 1. How is context, the Sargassum problem, and adaptation framed in the case-studies?*
- 2. How has framing of the Sargassum problem influenced aligning problems with solutions in the case-studies?*
- 3. How do the case-studies compare in terms of context, Sargassum framing and alignment with adaptation actions?*

## 1.4 Outline

This thesis consists of several chapters. The following chapter will elaborate on the concepts that will form part of the conceptual framework: framing and adaptation to environmental problems. The consecutive chapters include methodology, which will inform on the research design, selection of case studies, temporal delineation, data collection, data analysis, limitations of the research design, and the positionality, reliability and validity of the study. The results chapter is divided into two sub-chapters: (1) mapping out of the key frames; and (2) understanding the key frames and analyzing for alignment. The consecutive chapter will compare valuable insights from the results section between the case-studies. The discussion chapter will

review the study results and place them in wider literature debates. Lastly, the conclusions chapter will conclude the most important aspects of this research as well as present ideas for further research.



## 2. Conceptual framework

This chapter will first elaborate on the key concepts of framing of environmental problems followed by adaptation to environmental problems. After reviewing these concepts, we will arrive at the conceptual framework of this study. Lastly, the operationalization of the frames that will be used for this study's analysis will be defined.

### 2.1 Framing of environmental problems

Recognition of environmental degradation and its impacts on natural resources and human health has led to a wide range of approaches and attempts to address the adhering challenges (Salamat, 2015). However, when an environmental issue involves high degrees of scientific uncertainty it causes feelings of adversity which could undermine effective action (Morton, Rabinovich, Marshall, & Bretschneider, 2011). A particular approach to address these challenges has been the process of framing environmental issues in distinct ways by both people and nations (Salamat, 2015).

Framing analysis is considered an appropriate approach when wanting to analyze how an environmental issue is understood. Firstly, framing forms part of the social constructivist analysis of environmental policy and is especially helpful in identifying: "the underlying assumptions that steer and guide public and environmental policy" and thus serves as guidance to comprehend how actors act upon the issue in concern (Juhola, Keskitalo, & Westerhoff, 2011, p.445). Moreover, framing plays a crucial role in the decision-making process when the issue at hand is characterized as risky and uncertain (Salamat, 2015).

Clingerman and Ehret (2013) suggest that we cannot rely solely on understanding of an environmental change through scientific literacy and information but there is also the need for a narrative context that illustrates meaning i.e., frames. As Nisbet (2010) puts it: "Framing is an unavoidable reality of the communication process, especially as applied to public affairs and policy. There is no such thing as unframed information, and most communicators are adept at framing, whether using frames intentionally or intuitively" (p. 15). Moreover, frames not only direct our awareness to particular issues and their consequences, they also willingly or unwillingly take our awareness away from others (Ferree & Gamson, 2002). Our human brains typically think in terms of unconscious frames and a single word can activate a whole system of thinking which makes it crucial to understand which frames are being activated in the wider public (Lakoff, 2010).

Many scholars agree that framing plays a crucial role on adaptation to environmental problems. How adaptation to a particular problem is framed, can exert great influence on the form and success of measures

taken to adapt (Dewulf, 2013). Head (2014) also emphasizes the implication of frames on adaptation decision making with an example: “narrowness in the ‘frames’ for identifying problems leads to a narrowness in the frames for generating solutions” (p.669). Lebel et al., (2018) furthermore suggest how framing influences adaptation: “it prompts problem closure and guides response considerations, including identifying positions of responsibility and agency. Framing involves choices about which elements, relationships, linkages, and dynamics in play to consider and highlight, while other aspects are downplayed or excluded from consideration” (p. 430).

Studies on framing of environmental problems have mainly included the analysis of frames around the communication of climate change as understood by the general public (Morton et al., 2011; Spence & Pidgeon, 2010). Furthermore, studies have included analysis of how local governments are deliberately reframing climate change as a means of advancing climate adaptation planning and environmental policy (Juhola et al., 2011; Romsdahl, Kirilenko, Wood, & Hultquist, 2017). Harould-Kolieb (2020) studied the link between the framing of ocean acidification and its relation to policy action. The study concluded that the framing of ocean acidification has affected how this environmental problem is judged within multilateral environmental agreements.

## 2.2 Adaptation to environmental change

Adaptation to environmental changes cannot be more relevant in current times. However, as has become clear from the previous chapter, there are several uncertainties that need to be addressed. The uncertainties around the topic of Sargassum impose many challenges when it comes to adequate adaptation measures. For the most part, the literature on adaptation governance uses the terms “environmental change” and “climate change” interchangeably (Aswani, Vaccaro, Abernethy, Albert, & Fernández-López De Pablo, 2015; Lane, Clarke, Forbes, & Watson, 2013). Additionally, environmental change Sargassum and climate change issues have a large degree of uncertainty in common making the literature on climate change adaptation relevant for this research. For this reason, the following concept of adaptation to environmental change is largely built on literature concerning governing adaptation to climate change.

Adaptation governance in this context refers to “reactive or anticipatory actions by individuals or public institutions” (Cochrane, De Young, Soto & Bahri, 2009, p.108) by means of “adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts... changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities” (Smit & Pilifosova, 2003, p.879). Adaptation through a governance lens implies consideration of i.e., technical

advancements, institutional arrangements (e.g., stakeholder involvement), necessary policies, and spatial and temporal scales (Charles, 2012; Cochrane et al., 2009).

Adaptation at the destination level is important to reduce impacts and vulnerability, yet adaptation is not always easy. We can use the literature of Termeer, Dewulf, & Breeman (2013) on governance of climate change adaptation to identify why adaptation to environmental changes is particularly challenging. First, there is a context of fragmentation. Successful adaptation is largely dependent on the collaboration of many interdependent actors across various policy sectors. Exacerbating matters is that these actors all have their own set of interests, priorities, responsibilities, ways of framing the problem, resources, ambitions, and preferences. Second, there is a lack of a well-structured policy domain. Climate (or environmental) change adaptation has yet to institutionalize itself as an indisputable policy domain with e.g., clear set ambitions, responsibilities, and solutions. Third, there is inherent uncertainty in a knowledge-intensive domain. Climate change data and models have often a global characteristic making its relevance and application to the level of affected regions one highly speculative and therefore difficult to be accountable for and highly susceptible to unpredictable changes.

It is important to highlight the third point made by Termeer et al., (2013) since it is a crucial component that considers the difficulty of adaptation policy action when there is a lack of reliable knowledge and public understanding especially to a new phenomenon (Head, 2014). For example, Head (2014) studied the specific dynamic between adaptation strategies as responses to the wicked problem of climate change in an Australian context. The scholar argues that complex problems require another way of thinking: “strategies are needed to address the divergent perceptions of key stakeholders, and solutions pathways are likely to require long-term political and funding commitments” (Head, 2014, p.665). The high levels of uncertainty paired with the high degrees of local impacts creates space for diverse perceptions.

Theoretical and empirical studies on environmental adaptation in the Caribbean have focused both on adaptation policies that address climate change as a whole or one particular extreme climate phenomenon. An example on the former includes a recent study covering how food adaptive capacity and livelihood vulnerability are influenced by climate variability and weather-related disasters in Trinidad & Tobago (Shah, Dulal & Awojobi, 2020). An example of the latter is a study on the link between adaptation to hurricanes and how this is affected by “visions of development, governance structures and strategies to cope with hurricanes in the Mexican Caribbean” (Manuel-Navarrete, Pelling, & Redclift, 2011, p.249). Another example is a study on local climate change adaptation and governance of flooding in Trinidad and Tobago (Middelbeek, Kolle, Verrest, & Verrest, 2014).

The literature on adaptation in the Caribbean furthermore reveals that although there has been great effort in identifying how islands are vulnerable to impacts, the connection to adaptation planning has been quite limited (Thomas, Shooya, Rokitzki, Bertrand, & Lissner, 2019). A study by Thomas et al., (2019) analyzed adaptation planning documents of Caribbean countries and revealed that there must come improvement in: “(i) more direct linkages between identification of adaptation options and assessments of climate hazards, impacts, vulnerability, and risk; (ii) identification and appraisal of a range of adaptation options; and (iii) increased inclusion and usage of quantitative information about hazards and impacts” (p. 2013).

### 2.3 Synthesis of the conceptual framework

The literature presented above on framing of environmental problems and adaptation to environmental change give substance to the conceptual framework of this study (see Figure 4). The theoretical approach will be cognitive frame theory (Dewulf et al., 2009). Cognitive frame theory is highly relevant in this case since its focus is on: “the way that people experience, interpret, process or represent issues, relationships and interactions in conflict settings” (Dewulf et al., 2009, p.160). Moreover, Dewulf et al. (2009) states that the approach of cognitive frame theory considers frames as: “mental structures that facilitate organizing and interpreting incoming perceptual information by fitting it into already learned schemas or frames about reality” and thus “framing is the process of applying cognitive frames to situations” (p.158-162). Especially fitting this study on how Sargassum is understood, the cognitive frames approach addresses what is believed to be external reality by analyzing how information is represented and processed (Dewulf et al., 2009).

This study builds on the components of several studies and the underlying assumption is that how an environmental problem is framed will influence policy action (Harrould-Kolieb, 2020). Therefore, adaptation to an environmental problem is affected by frames surrounding the issue and matters of situational context. First of all, Moser & Ekstrom (2010) define context to be part of the diagnostic framework that consists of: “interacting actors, the governance and larger socio-economic context, and the system of concern that is to be managed” (p.22028). In other words, the actors form the “governing system” and the system of concern in relation to Sargassum is the “system-to-be-governed” (Jentoft, van Son, & Bjørkan, 2007). There is the need to first understand how these elements of the local/national context in relation to Sargassum are framed in order to understand the respective adaptation responses at the local/national level.

Adaptation to an uncertain environmental issue is different in every situation and thus has no defined correct approach, yet is greatly dependent on the influence of framing, the context and purpose (Fleming et al., 2015; Mossler, Bostrom, Kelly, Crossman & Moy, 2017). Therefore, understanding the *situational context* is a significant element in the adaptation process. In this case, *situational context* framing refers to how

stakeholders, the larger political and socio-economic structure, and their interactions and concern with Sargassum are understood and communicated. Secondly, as can be noted from the literature review, framing of a specific environmental issue can help define the formulation of adaptation responses to the environmental change in question. In the case of Sargassum, framing is a tool that could be used as a means to exercise influence on adaptation choices and planning. The diagram in Figure 4 depicts the relationship between situational context framing, Sargassum framing and framing of adaptation responses to the environmental issue.

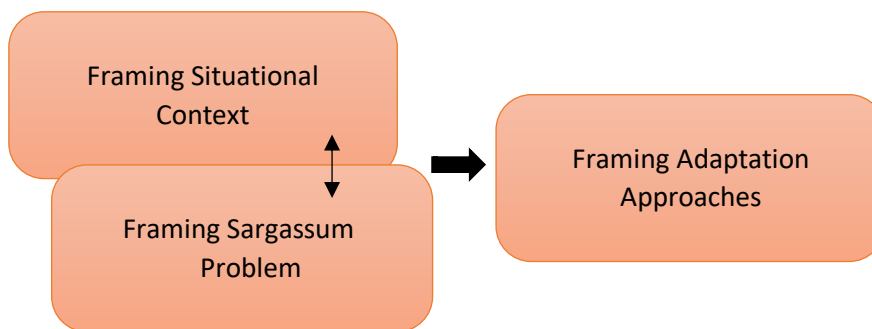


Figure 4. Conceptual Framework

## 2.4 Frames operationalization

The framing analysis consists of three separate categories of frames: *situational context*, *Sargassum*, and *adaptation governance*. The first category consists of the contextual frames based on a study by Moser & Ekstrom (2010). These are aspects that address the setting and particularities of the location which help indicate the space and local characteristics of the case study in relation to Sargassum. These frames are the wider *socio-economic setting* in which they operate and the *system of concern* that has been affected by Sargassum. The second category is how Sargassum the phenomenon is framed. These frames are based on Cramer (2008) who identified the primary frames around climate change which are: *environmental*, *scientific*, *political*, *economic consequences*, *human interest*, and *other*. These frames were adopted due to the relevance of these frames for the Sargassum phenomenon. The final category is based on elements that compromise i.e., adaptation governance: *technical solutions*, *institutional arrangements* (e.g., stakeholder involvement), *necessary policies*, and *spatial and temporal scale* (Charles, 2012; Cochrane et al., 2009). See the tables below for the list of frames and their elaboration.

<b>Situational context framing</b>	<b>Description</b>
<i>Socio-economic setting</i>	This is the larger context in which the actors act, such as socio-economic characteristics that help explain the local/national context
<i>System of concern</i>	The interaction with Sargassum at local and national level; local/national characteristics that are impacted by Sargassum

Table 1. Context framing and description. Adapted from Moser & Ekstrom (2010)

<b>Sargassum problem frames</b>	<b>Description</b>
<i>Environmental</i>	Aspects that address matters of the natural environment and impacts on flora and fauna e.g., biodiversity
<i>Scientific</i>	Aspects that focus on scientific research, and technical data
<i>Political</i>	Aspects that address government and political side of the Sargassum issue
<i>Economic consequences</i>	Aspects that address issues in the context of economic implications of Sargassum on a country, region, institution, business, industry, or an individual. These can be both negative and positive e.g., business opportunities, and direct or indirect
<i>Human interest</i>	Aspects that address the social impact of Sargassum i.e., the effect of this phenomenon on people. For example, access to water, food production, health implications
<i>Other</i>	Notable and/or interesting points that do not fall under the frames above

Table 2. Sargassum frames and their elaboration. Adapted from Cramer (2008)

<b>Adaptive governance frames</b>	<b>Description</b>
<i>Technical</i>	Adaptation is formulated as a technical matter e.g., involving technology or engineering
<i>Institutional</i>	There is evidence that the issue requires implications for institutions
<i>Policy</i>	There is mention of policy implications
<i>Spatial scale</i>	Adaptation planning is considered at different scales e.g., local, regional, national
<i>Temporal scale</i>	Adaptation is considered at different temporal scales i.e., short- to long-term
<i>Other</i>	Notable and/or interesting points that do not fall under the frames above

Table 3. Adaptive governance frames and their elaboration. Adapted from Charles, 2012; Cochrane et al., 2009

### 3. Methodology

The following chapter will elaborate on the methodology i.e., the process and methods applied throughout the study. The sections elaborate on the research design, the selection of the study cases, data collection, selection of frames, data analysis, study limitations and positionality.

#### 3.1 Research design

This study is formulated as a regional case study by analyzing three different countries from the WCR. The study takes first a deductive research approach where communicated Sargassum data was sorted according to the existing framework of frames presented in section [2.4](#). The categorization of the data according to these frames resulted in a quantitative analysis intended to specify the dominant frames present in the data. Hereafter the study takes on a qualitative approach by conducting a content analysis where important themes were defined. Fine & Elsbach (2000) indicate one of the biggest strengths of qualitative data analysis is its ability to “accurately describe real-world issues and processes... Their complexity gives a picture of informants’ meaning of social world and behavioral processes that might not otherwise be available” (p. 55-56). Lastly, the themes that were derived from the qualitative data were analyzed for congruency and alignment between the dominant frames of context, Sargassum and adaptation actions.

#### 3.2 Selection of case studies

The WCR consists of 28 islands and continental countries located in the Gulf of Mexico, Caribbean Sea, and parts of the North Atlantic Ocean (UNEP, n.d.). The territory spans from the state of Florida of the U.S.A in North America all the way down to French Guiana in South America (See Figure 5). To make this study as representative as possible but also feasible given the limited amount of time, it was decided to spatially delineate the research to three specific countries from the WCR. These three case studies were chosen on the basis of three criteria and an explorative search through online news media. The first criteria considered that online news media reported that the country has seen significant presence of Sargassum on its shores. Second, that there was relatively enough data publicly available to conduct the analyses. Third, that there would be significant diversity in country size between the case studies and location within the WCR. An educated guess was made based on the findings and two island countries – the Dominican Republic and Trinidad & Tobago – were chosen, alongside the continental country of Mexico. The following paragraphs will summarize some of the case studies’ most important characteristics in relation to this study (e.g., geographical location, population size and importance of the tourism sector).



Figure 5. Map of the Wider Caribbean Region depicting case studies (Source: Petchary, 2016)

### 3.2.1 Dominican Republic

The country of the Dominican Republic (DR) has a population of 10,5 million inhabitants and occupies two-thirds of the island of Hispaniola, while Haiti occupies one-third to the west (See Figure 6; CIA, 2020). The DR is one of the most visited destinations in the Caribbean and tourism has grown to become one of the most important sources of foreign exchange (Gonzales & Wiarda, n.d.). In 2018, the DR received 6,6 million international tourist arrivals, and tourism accounted for 37 percent of exports (UNWTO, 2020). Like the majority of the islands in the Caribbean, coastal development is significant, especially in the south where population is also the highest (CIA, 2020). The main tourist sites are located along the coast i.e., La Romana, Puerto Plata, Punta Cana and Santo Domingo (Gonzales & Wiarda, n.d.).

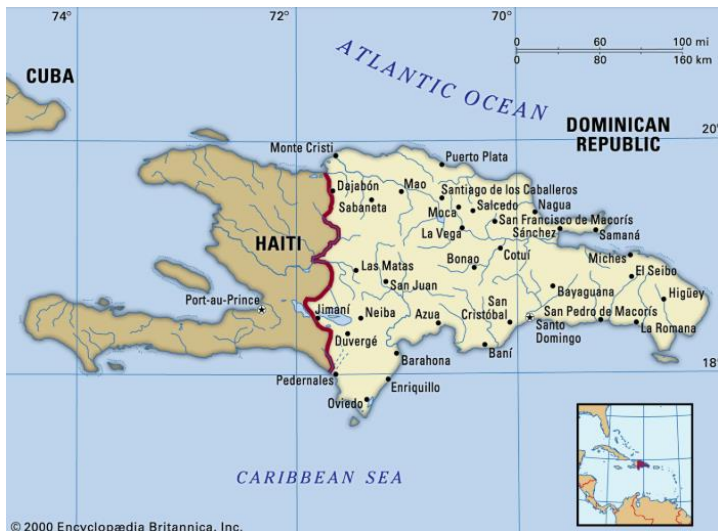


Figure 6. Map of the Dominican Republic and Haiti (Source: Encyclopaedia Britannica, 2000)



### 3.2.2 Mexico

Mexico is a country of North America and has a population of approximately 128,6 million (CIA, 2020). Mexico is currently the world's 6<sup>th</sup> most visited country, and tourism has placed itself as the third-highest industry in Mexico (Webster & Lima, 2019). Travelers, mainly from the U.S., are attracted to the culture, tropical aesthetics, low prices and easy accessibility (Palerm et al., 2020). In 2018, Mexico received 41,3 million in international tourist arrivals which accounted for 5% of total exports (UNWTO, 2020). Many kilometers of long stretches of beaches are found to the southeast of Mexico along the shore of the Yucatan peninsula (Quintana Roo state) which is host to popular destinations such as Cancun, Cozumel and Riviera Maya (Palerm et al., 2020).



Figure 7. Map of Mexico (Source: Encyclopædia Britannica, 2007)

### 3.2.2 Trinidad & Tobago

The Republic of Trinidad and Tobago (T&T) is an island country that is located off the coast of Venezuela and consists of the two main islands of Trinidad and Tobago and some smaller islands (See Figure 8; Watts, Brereton & Robinson, 2020). Its population is at approximately 1,2 million inhabitants and although tourism is an important sector in T&T, the economy relies largely on the production and processing of petroleum and natural gas on the island of Trinidad – making it one of the most prosperous countries in the Caribbean (CIA, 2020). Trinidad is by far the largest of the two islands, with tourism concentrating in the northwest, while Tobago is much smaller yet where most tourism activity takes place (Watts et al., 2020). Data from 2016 to 2018 shows that T&T has seen a decline in tourism arrivals, accounting for 0,4 million visitors in 2018, and for 5% of total exports (UNWTO, 2020).



*Figure 8. Map of Trinidad and Tobago (Source: Encyclopaedia Britannica, 1998)*

### 3.3 Temporal delineation

Despite that the unusual amount of Sargassum influx initiated in 2011, it were the years of 2015, 2018 and 2019 that the Sargassum quantity was the most severe (Wang et al., 2019; Montevago, 2020). It is therefore believed that these three years would provide the necessary data and would also be the most interesting to study in terms of framing of Sargassum in the news media. In the case of analyzing the adaptation solutions in policy or other government documents the year of the issue or report was not only exclusive for these years. The year these reports were written could be an interesting indication, and for this analysis the adaptation characteristics were the most important component.

### 3.4 Data collection

The first method of this research is focused on the study of framing based on cover stories of Sargassum in online news articles and local/national policy documents or management guides. Firstly, online news articles were chosen as the unit of analysis since this channel of communication would be most inclined to provide framed information as it communicates news to the wider public. As Cramer (2008) states: “The media are the primary framing institution of our time and dramatically influence the way we view current issues” (p.23). Furthermore, online news articles were chosen as these would be easily accessible and thus enable the comparison of the case studies. Secondly, policy documents and management guides were chosen as these would provide the necessary data on how adaptation governance is framed and has taken form.

The media news articles were found through online search engine “Google”. The keywords used were “Sargassum”, “seaweed” and “algae” in combination with the name of the country i.e., “Dominican Republic”, “Mexico”, “Trinidad & Tobago” and year i.e. “2015”, “2018” or “2019”. Other keywords included the Dominican republic’s coastal state of “Punta Cana”; the Mexican coastal state most affected by Sargassum which is “Quintana Roo”; and the individual search terms of “Trinidad” and “Tobago”. In the case of Dominican Republic and Mexico these keywords were also searched for in Spanish i.e., “Sargazo”, “algas”, and “Republica Dominicana”. The number of news articles found for the years of 2015, 2018 and 2019 were in total 24 for the DR, 26 articles for Mexico, and 12 articles for T&T.

The policy documents, management guides or other form of adaptation information were sought from online sources, as well as through contacts if these were not available online. The keywords for the online search were the country’s name i.e., “Mexico”; “Dominican Republic” (and “Republica Dominicana”); Trinidad & Tobago (also “Trinidad” and “Tobago”); in combination with “Sargassum” (and Sargazo); “management guide”; “management document”; “policy document”; and “policy guide”. For the DR, the Sargassum management strategy “Impacts and Challenges of the Sargasso in the Dominican Republic” was presented in November of 2019. For Mexico, the Sargassum strategy document named “Technical and Management Guidelines for Attention of Contingency Caused by Sargazo in the Mexican Caribbean and the Gulf of Mexico” was presented in July of 2019. For T&T, Trinidad has their “National Sargassum Response Plan”, which became available in January of 2016, while for Tobago, there is no response plan to the Sargassum challenge since this is still in review.

### 3.5 Data analysis

This study takes on several forms of data deduction in order to reach the final analysis aim. The first is a quantitative analysis to map out the dominant frames in the online news media. The data gathered from the online news stories and management guides were categorized according to the pre-defined frames (section [2.4](#)). The following step was calculating the number of statements made under each frame to define the most dominant frames.

For the category of *Context*, the two frames *Socio-economic setting* and *System of Concern* were chosen as the two baseline frames to be analyzed for all three case-studies to understand the situational context. Consecutively, the two main frames for *Sargassum* were identified according to the highest percentages indicating the most popular frames that came forward from the content. Lastly, for the category of

Adaptation the frames of *Technical, Institutional, Policy, Spatial scale, Temporal scale* and *Other* were all considered to identify in detail adaptation actions (See Figure 9).

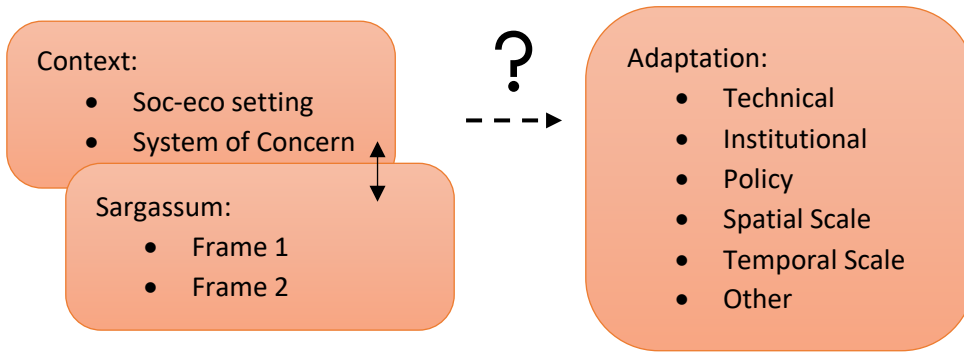


Figure 9. Visual representation frames selection

The following step entailed content analysis and coding of these frames. Content analysis is a data collection form in which systemic analysis of some form of communication is carried out (Adler & Clark, 2007). This content analysis is qualitative in nature as it intends to interpret and understand perception and human behavior. The content of these frames were analyzed by means of open coding to create themes. Open coding entails analysis of the content of the frames and elements through labeling concepts to develop categories that will help identify themes and thus provide construction of meaning (Williams & Moser, 2019).

Lastly, the themes were analyzed for alignment between frames of *Context* and *Sargassum* with *Adaptation*. This approach was adopted from Harrould-Kolieb (2020) who studied the alignment of framing of ocean acidification and multilateral environmental agreements with the aim to understand where there could be indication of congruence and alignment between framing and adaptation action taking. This was defined by the co-presence (or not) of the themes in situational context and sargassum problem and between the respective adaptive approaches.

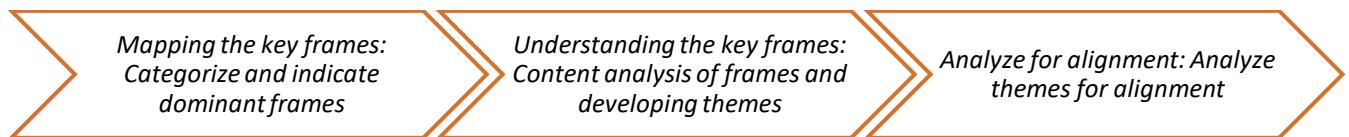


Figure 10. Steps of the analysis process

Step 1. Mapping the key frames: Quantitative analysis of all data categorized to define the most recurring frames by percentage.

Step 2. Understanding the key frames: Content analysis of the dominant frames and defining themes from the data.

Step 3. Analyze for alignment: analysis of alignment and consistency between the themes of *Context* and *Sargassum* and *Adaptation* approaches.

### 3.6 Limitations research design

The research design of this study does naturally encompass its limitations. First of all, the analysis of news media did not include other forms of local news channels for example, actual local newspapers, news videos, and other platforms like social media. Only reviewing the online article content provides a partial understanding of the perceptions on the topic. Furthermore, the online news sources are formulated according to what the news reporters consider to be most important and their perceptions surrounding the topic could be biased. Lastly, the research findings might not be generalizable to all other countries facing the same difficulties, however, the three case studies were deliberately chosen to provide different contexts and therefore provide a broader understanding of how countries in the WCR are coping with the situation.

### 3.7 Positionality, reliability, validity

Being born and raised in the Caribbean, environmental changes and its implications for small island states and adaptation strategies have been core interests of mine. Sargassum is a perfect example of a current challenge concerning environmental governance in the WCR. During my internship period at the UNEP – Cartagena Convention head office in Jamaica (July to December of 2019), Sargassum was a reoccurring hot topic. Sargassum was one of the topics I worked the most on and I also got the opportunity to attend the first International Sargassum Conference that took place in Guadeloupe in October of 2019. Furthermore, I also had the chance to attend the Interregional Workshop on the Use of Nuclear Techniques for Sargassum Control that took place in Jamaica in November of 2019. Both events granted me the opportunity to get in touch with several stakeholders and have broaden my perspective and knowledge on the topic much further.

Concerning the research's reliability, it can be argued that the content analysis was performed according to the interpretation of one researcher. However, the analysis did follow an explicit coding scheme and was an iterative process, adjusting for any oversights from earlier analysis along the way (Adler & Clark, 2007).

Regarding the validity of the study, it needs to be mentioned that this study does not cover all aspects that could ultimately influence environmental adaptation governance in a country and only relies on an analysis of a number of crucial factors. Furthermore, content analysis can only address that which there is recorded communications of (Adler & Clark, 2007). Nonetheless, the data that was analyzed was largely what was available from online news sources and careful attention was paid to the case studies' context and thus did provide an appropriate data base for the analysis of this thesis.

## 4. Research findings

This chapter will elaborate on the research findings according to the case-studies. The first sub-chapter will address the quantitative analysis and will map out the dominant frames for the categories per country. The second sub-chapter will elaborate on the qualitative analysis and will address the contents of the main frames that resulted in the formation of themes. Moreover, alignment between the themes of the frames will be discussed.

### 4.1 Mapping key frames (Step 1)

The following sub-chapter will present the results of the quantitative analysis based on the online news articles for each country and Sargassum management plans. The results of this analysis are presented as the top two frames that were communicated for *Sargassum*. For the full tables covering the frames according to the online news media articles and percentages per country see Appendix I.

#### 4.1.1 Dominican Republic

For the DR, quantitative analysis revealed that the dominant frames for *Sargassum* were: *Environmental* and *Human Connection*. See Figure 11 for overview of frames.

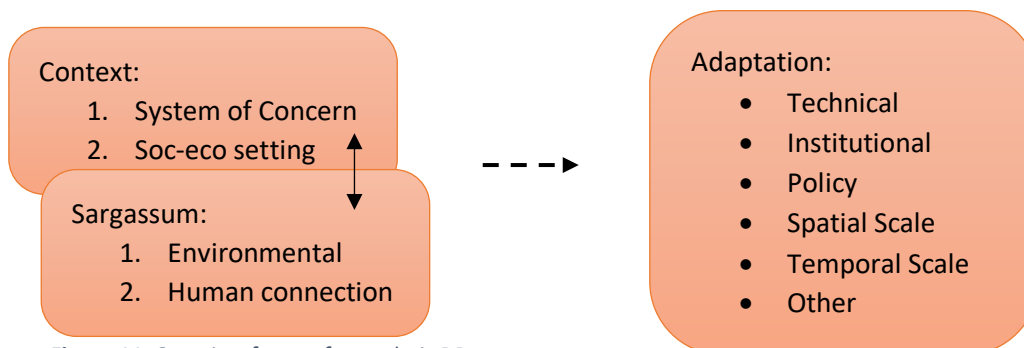


Figure 11. Overview frames for analysis DR

#### 4.1.2 Mexico

For the second case study the top two frames for the Sargassum category were: *Human connection* and *Economic consequences*. See Figure 12 for overview of frames.

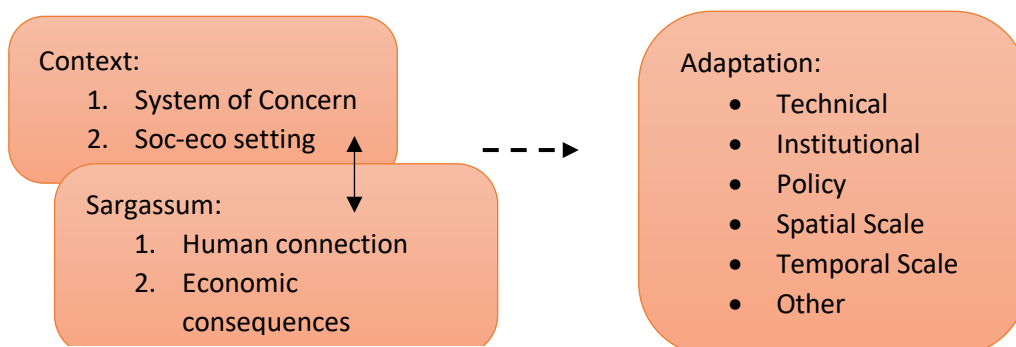


Figure 12. Overview frames for analysis Mexico

### 4.1.3 Trinidad & Tobago

For the third case study the top frames for Sargassum were: *Environmental* and *Human connection*. See Figure 13 for overview of frames.

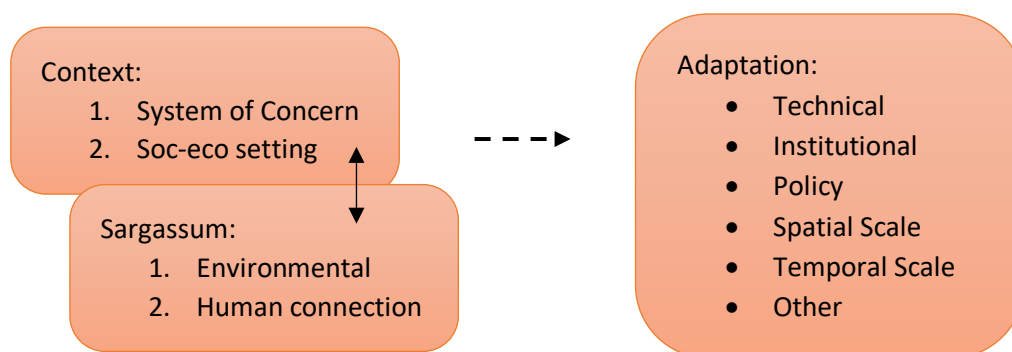


Figure 13. Overview frames for analysis T&T

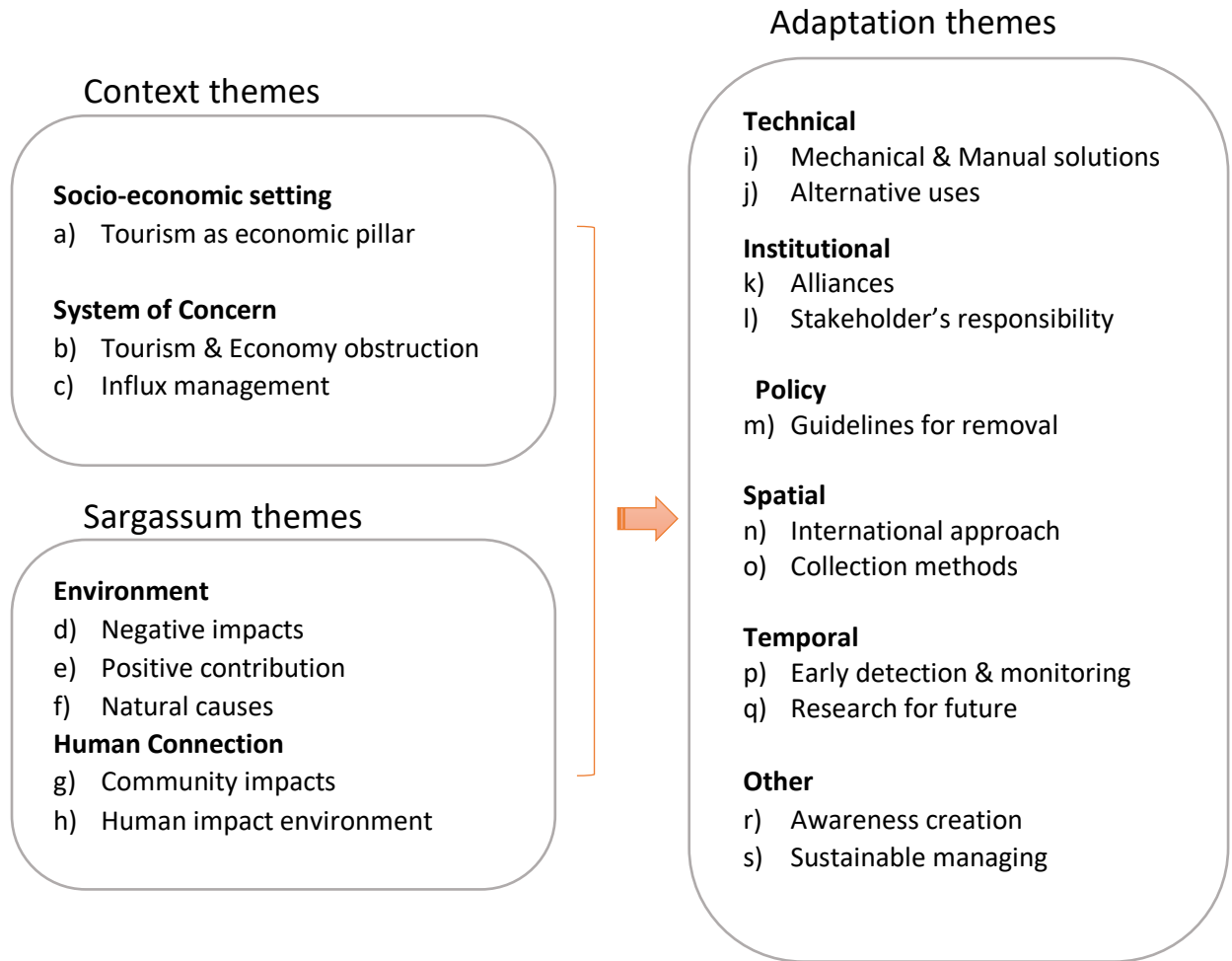
## 4.2 Understanding the key frames and analyzing for alignment (Step 2 & 3)

The following section will present the themes that came forward from the content analysis of the key frames indicated in the previous section. The themes are presented in figures 14-16. The themes have been organized and are presented in a figure according to the three frame categories. Furthermore, the themes have been numbered by alphabetical order so it would be easier to refer back to the figure when reading the analysis findings per case-study. Additionally, this section will address the alignment of themes between *Context*-, *Sargassum*- and *Adaptation* frames for the case-studies.

### 4.2.1 Dominican Republic

Analyzing the themes for the frames of *Context*, *Sargassum* and *Adaptation* for the DR resulted in some interesting matters (See Figure 14). First of all, the main theme that came forward for the situational context frame *Socio-economic setting*, is that *tourism is the economic pillar* (a) of the DR. The dependency of the economy on tourism is currently being threatened by Sargassum, resulting in country-wide economic impacts. Consequentially, tourism and economy obstruction (b) was a major *System of concern*. Focus was laid largely on how Sargassum affects the tourism sector i.e., through the tourist experience, decline in occupancy rates, impacting quality and reputation of the destination and, moreover, also future scenarios if discontent of tourists keeps increasing.





*Figure 24. Depiction of themes and frames of Context, Sargassum and Adaptation actions in DR*

As adaptive response, the impact of Sargassum on tourism is targeted through multiple channels: mechanical and manual clean up solutions (i) e.g., cranes, vehicles, mechanical shovels and barriers to keep the beaches clean; early detection and monitoring (p) of satellite images; guidelines for removal for hoteliers (m); collection at high seas (o) so it doesn't reach the shore and affect tourism; reaching out to seek solutions at the international level (n); and adaptation by the tourism industry by turning the crisis into an opportunity by creating awareness (r) and by inviting the tourists to learn about it.

Another concern was the influx management (c) of Sargassum. This was indicated by a lack of action by local authorities and management capacities not being sufficient to manage the influx in 2015 nor 2019. Adaptation hereto has largely taken on the form of on-sight coping mechanisms in the form of *Technical adaptation* i.e., barrier placement in coastal waters and/or mechanical and/or by hand clean up (i) once it reaches the coastline. Furthermore, the pressure to manage the influx due to the impacts on the tourism

industry, has resulted in the formation of new alliances (k) between Ministries and the hotel sector; between public-private organizations to carry out studies needed; alliances between national and regional institutions; and the formation of an inter-institutional table.

Influx management (c) was a concern since there has been an ongoing debate regarding stakeholders' responsibility (l). The private, but mainly the public sector are seen as the ones responsible for e.g., the managing of the cleaning programs, freeing the tourism industry from the multiple burdens, maintaining the good reputation that the DR has as a popular beach destination, and reliance for financial help. Some hotels have set up their own cleaning programs instead of relying solely on the government for support of cleaning brigades. Another adaptive action that has been proposed for the management of the influx is to consider and carry out research (q) regarding the effects on the marine coast as well as finding alternative uses (j), especially in economic forms for Sargassum. Lastly, it was indicated in the management guide that sustainable management (s) of the influx is desired. This would be in the form of sustainable barriers placement and the balanced removal of Sargassum and its placement on eroded beaches for beach nourishment.

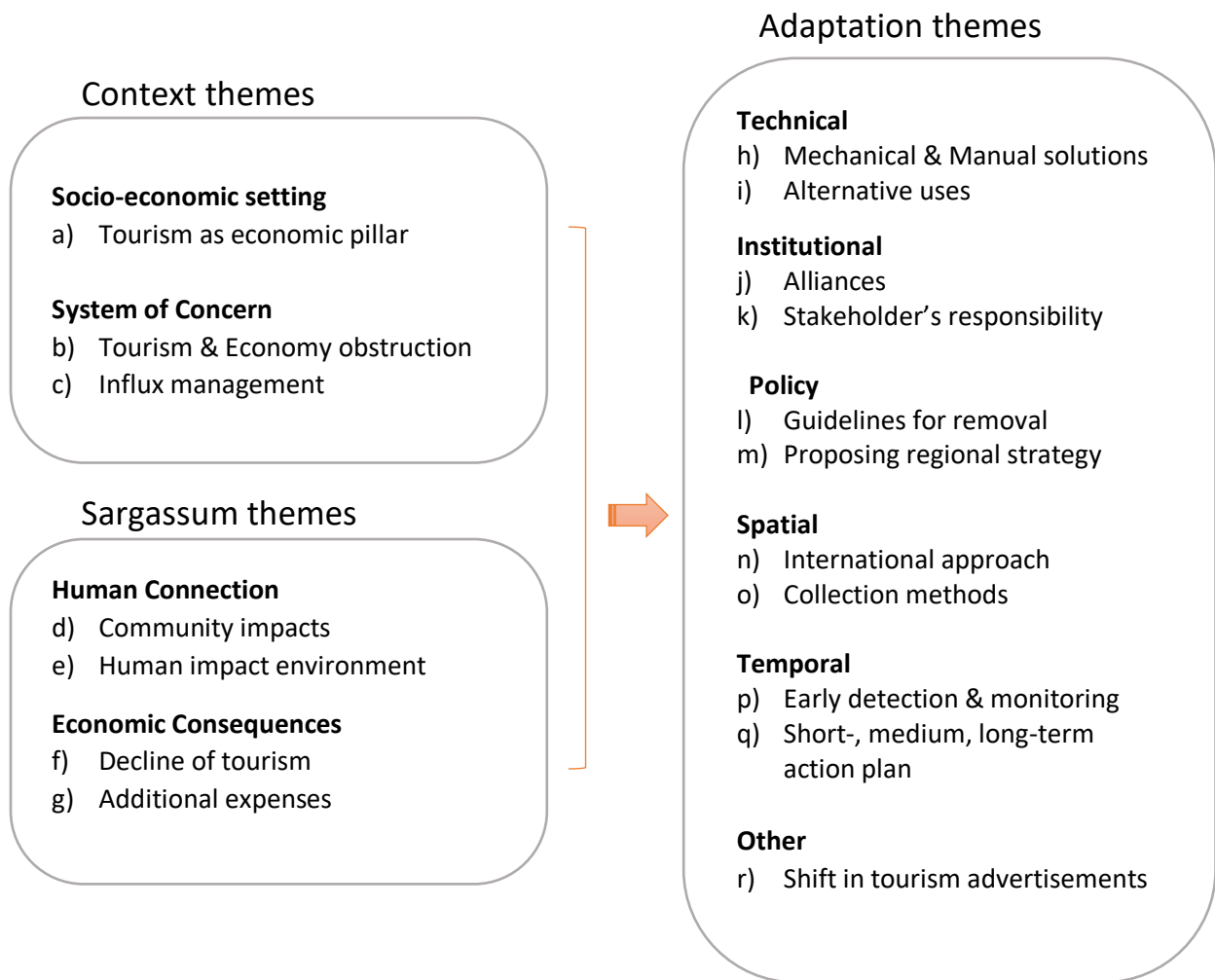
For the top two frames for *Sargassum*, adaptive responses have been limited. First, Sargassum has been framed mainly as an *Environmental* aspect, fostering both negative (d) and positive contributions (e) – especially on the coastal ecosystem. In 2018, the massive arrivals were described as an ecological disaster in the DR. Some negative impacts include death of marine animals, salinization of the soils, oxygen reduction and blockage of sunlight in coastal waters, impact on water quality, and changes in ocean content. On the other hand, positive contributions include the oxygen it produces for our planet, food and shelter for animals, medicines, and it balances beach soils. The *Technical* adaptation actions have been largely devoid of environmental considerations, except for concerns of large sand loss due to mechanical (i) beach clean-up. The other theme has been the natural causes (f) contributing to the phenomenon such as abundance of nutrients by the Saharan dust or El Niño phenomenon.

Lastly, the other main frame for Sargassum which is *Human connection*, although an important frame that came forward from the online news sources, has seen minimal forms of alignment with adaptation actions. This might be because it is not perceived that Sargassum has impacted locals in mayor ways. Fishermen of the coastal communities (g) have been allegedly impacted by more abundance of fish due to the Sargassum mats but hindered in their ability to reach the open seas with their boats. Furthermore, it has not been perceived that Sargassum has any major health impacts on humans and that overall people should focus more on the positives than the negatives. Lastly, although there has been a link recognizing that human

activity (h) contributing to global climate change is what is altering sea dynamics and so causing the proliferation of the blooms, there has not been any mention on behalf of the DR of ways to adapt or even address this problem.

#### 4.2.2 Mexico

From the three case studies, Mexico has witnessed the most amount of Sargassum on its coasts. In 2015 about 180.5 kilometers of beaches in Quintana Roo were covered in Sargassum (Velasco, 2015). The overarching theme that characterizes the *Socio-economic context* for Mexico is that, like the DR, tourism is considered an economic pillar (a; See figure 15).



**Figure 35.** Depiction of themes and frames of Context, Sargassum and Adaptation actions in Mexico

Logically, the main themes for *System of concern* were tourism & economy obstruction (b) and the difficult task of influx management (c) that Mexico has had to cope with considering the massive quantities of Sargassum that was washing up on its shores.

Tourism was a critical concern in the *Context* and *Sargassum* frames in various ways. For the former, tourism and economy obstruction (b) concerns the impacts of Sargassum on multiple levels. For example, Sargassum has been framed as a threat to tourism by ruining honeymoons, threatening hotel occupancy, and causing discontent with abroad tour operators for not warning tourists about the state of the situation. Second, tourism is considered as a main economic pillar with multiple ripple effects for the country's economy. For example, in 2018 a drop of 30% in tourism, caused a total economic damage of 247 million euros (Mexia, 2019).

Concern of influx management (c) has been particularly difficult considering that with each annual massive influx, there would be changes in what was known at the time to be the usual phenomenon characteristics. Points of concern for management were: the amount that would arrive would exceed expectations each year, concern that the situation will continue, and that it will keep increasing in volume. By 2018, the influx arrived in unprecedented months and since 2019 it arrived almost year-round. Once it became clear that Sargassum would continue to be a recurring problem, and to lessen the burden on the tourist sector, a few adaptation measures were considered. *Technical* approaches were taken in the form of *mechanical solutions* (h): investments in containment barriers and boats to collect the Sargassum at sea; projects to establish alternative uses (i) and the industrialization of Sargassum were encouraged; and an early detection system and monitoring (p) for arrivals was developed.

The frame of *Human connection* for Sargassum considered the community impacts (d) the phenomenon has had on the local population. These have been mainly in the form of negative social impact, mainly related to the labor market. Already since 2015 loss of temporary and permanent jobs was reported. The decline of tourism affected the quantity, quality, and location of employment of many reliant on the industry (Fuentes, 2015). Some of these jobs were recovered by the large amount of manpower that was needed to clean up the beaches (h) e.g., 520 temporary jobs were created in the peak period of 2018. Furthermore, the State Government also aiming to address the large loss of jobs used federal funds for a temporary employment program (Fuentes, 2015). Nonetheless, the state of Quintana Roo has reported an increase in criminality and murder rate due to the loss of jobs and decline in tourism, and thus highlights another impact of the phenomenon.

For the second theme Human impact on the environment (e) the emphasis was laid in the media on the influence of human activity that has resulted in environmental change. Many examples of the human contribution to the Sargassum phenomenon were addressed: pollution of regional waters with the increase in nutrients and fertilizers by the agriculture industry and untreated wastewater discharge; deforestation of

the Amazon forest increasing the runoff of pesticides and fertilizers; and increase in CO<sup>2</sup> accounting for Global warming and increase in sea temperatures and changes in sea currents. The hotel sector of Quintana Roo has been advocating since 2019 to find a solution at the origin of the problem, since they believe that it is not a matter of adapting to the situation but of preventing it from happening. Moreover, there is the strong feeling of wanting to go beyond local action and preventing it from happening by addressing the issue at an international level (n) and by holding summits with other regional counterparts.

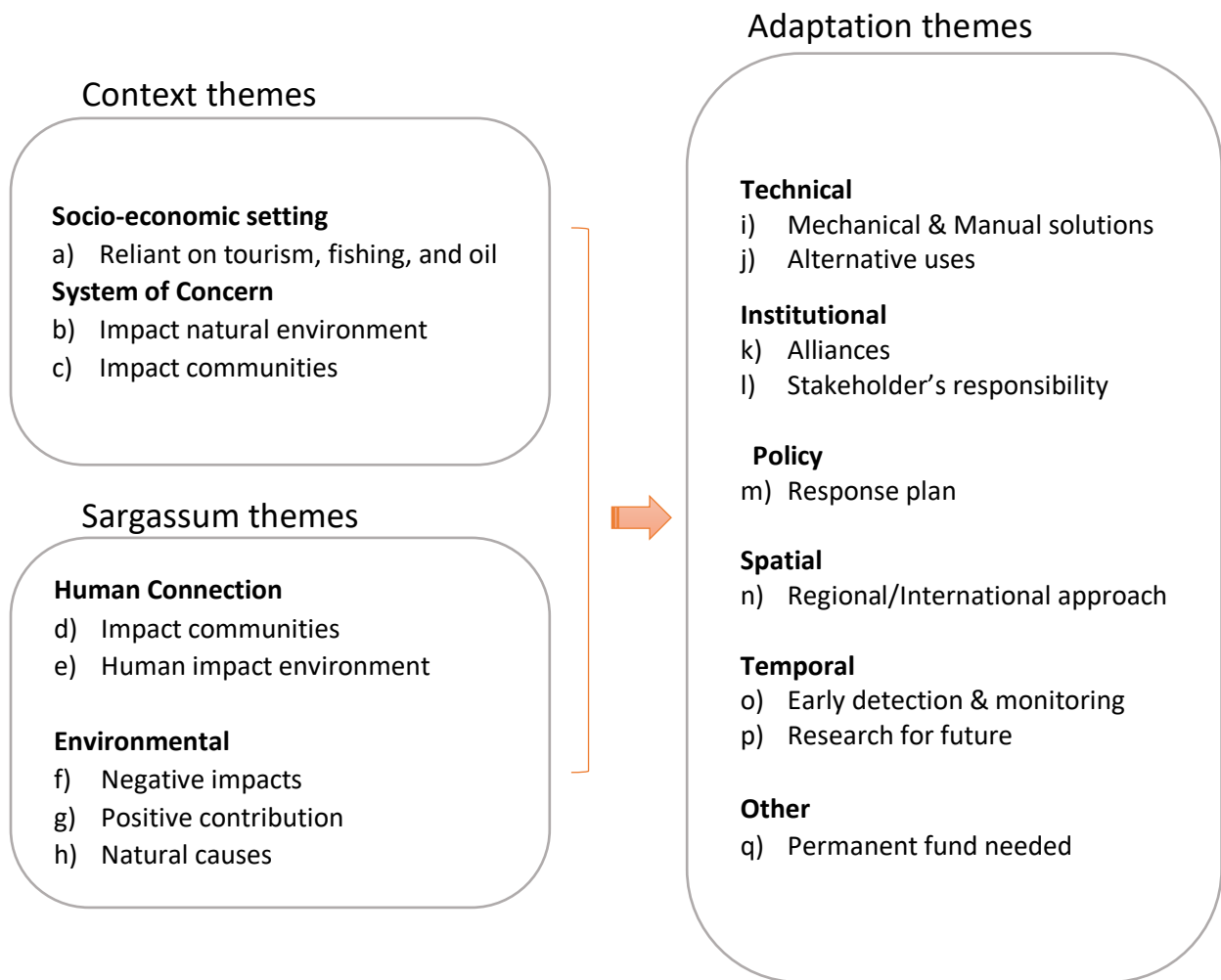
For the *Economic consequences* frame, a main theme has been the decline of tourism (f). Adaptive actions have been taken in several forms to reduce the impact on the tourism sector. *Technical* measures have been taken to reduce the accumulation of Sargassum on the beaches by daily manual and machine clean-up (h), increasingly installing barriers and collection by boats in the main touristic beaches, and by monitoring (p) the influx so that proper measures could be taken for its collection. However, even though the use of barriers has been promoted, it cannot be used extensively on the 900-kilometer coast of Quintana Roo (Perez Ortega, Toche & Vidal Valera, 2019). In *Institutional* terms, several new alliances (j) have been responsible for different collection methods (o) of Sargassum at different phases: the Navy is responsible for collection at the high seas while the municipal government and hoteliers clean the beaches. Lastly, the decline in tourism has led to tour operators and hoteliers to also take adaptive measures. There has been a recent shift in tourism advertisements (r) by selling Sargassum-free beaches and reducing hotel rates to make them more attractive to tourists.

Furthermore, the phenomenon has been responsible for a large increase in additional expenses (g) for the government, the private sector, as well as the tourist. Because the scale of influx and impact level on the Mexican Caribbean coast has been drastic, cleaning costs have been massive. Hotels have taken an individual approach and have taken the responsibility (k) of keeping the beach in front of their properties clean. In 2015 it was reported that the government spent an amount of US\$9 million on machinery and workers (h) for cleanup. Exceeding the budget for Sargassum removal work, funds had to be allocated from the Tax Administration Service. Consequently, a special budget was created on behalf of the government to combat Sargassum, but with less tourists coming, government revenue has also declined – causing financial deficits greater than projected (Animal Politico, 2019). Even tourists have had to adapt between settling for a beach that is cleaned daily or opt to spend more money on an excursion to visit a beach free of Sargassum.

On a *Temporal* scale, until 2018 actions were more concerned with the removal of Sargassum than trying to understand and stop this phenomenon. Consequentially, the government has been criticized for not providing enough resources to deal with the problems or only providing in-the-moment support and not

thinking in the long-term. In adaptive *Institutional* terms, talks of establishing a state or national coordinating body to mitigate Sargassum were communicated in 2019. Lastly, on a *Policy* scale, efforts have been made to formulate a joint Regional strategy (m) by inviting other Caribbean countries to a Sargassum Summit that took place in Cancun in June of 2019, where countries shared their experiences with Sargassum, but which did not result in any concrete plans for action on a joint Regional level.

#### 4.2.3 Trinidad & Tobago



**Figure 16.** Depiction of themes and frames of Context, Sargassum and Adaptation actions in T&T

Trinidad and Tobago as two separate islands, have had different experiences with Sargassum. First of all, the socio-economic context is also relatively different for these two. Tobago's economy relies greatly on the tourism industry, while Trinidad's economy is much less reliant on tourism but much more dependent on the oil industry. Furthermore, the fishing industry as a form of economic income or for own consumption is

important for both (a; see Figure 16). Both islands are affected by the influx mainly on the Atlantic coast, which has caused significant impacts for the east coast communities. For T&T the *System of Concern* has been the impact that the natural environment (b) and local communities (c) have suffered and what they have yet to suffer in the future. For the former, a lot of concern has been raised regarding the massive amounts of thick mats that pile up along T&T's coastlines. In 2015 the invasion was considered a natural disaster which took 30 days to clean up. In 2018, once again the massive influx had impacted T&T's coasts so much that they declared it an ecological disaster at the scale of an oil spill. Coastal communities were also heavily impacted, especially rural fishing villages reliant on fishing practices. Whenever there was a massive influx, it covered the beaches where boats anchor and it brought the fishing industry to a standstill.

The impact on communities (d) was accordingly also a core theme for the *Sargassum-Human connection* frame. Sargassum has been responsible for disrupting fishing activities of up to 800 fishermen in 2019 and damaging fishing boats causing concern for the livelihoods of fishermen and coastal residents. Furthermore, Sargassum has been considered as a health hazard for the coastal communities with the decaying Sargassum giving off pungent scent and gas. Moreover, there is also the community impact as a consequence of the impact on tourism and economy i.e., cancelled bookings. Lastly, communities and local authorities were also left with the responsibility of cleaning-up the seaweed. The second theme for the *Sargassum-Human connection* frame is that the phenomenon is the result of human impact on the environment (e). Acknowledgement and clear links have been made by the news sources of T&T between the impact of human activity and climate change and global warming, indicating that decades of pollution, nutrient flows, deforestation, overfishing and coastal development have led to the current situation.

The environmental frame focused on the negative impacts (f), positive contribution (g), and natural causes (h) related to Sargassum. The positive contributions include beach nourishment, shelter and food for endangered species and shore stability. On the other hand, the negatives include unwanted biodiversity, threat to turtles, shading coral reefs and seagrass beds for months, and turning the coastal waters anoxic. Furthermore, other natural contributors to the phenomenon are also emphasized like nutrients from upwelling and dust from Africa.

Adaptation for T&T has taken on several forms. In terms of a policy strategy, the response plan (m) has three main components: early warning, response, and communication. The early warning component relies greatly on new alliances (k) formed. There has been the formation of an "Early Warning" group consisting of the Trinidad & Tobago Meteorological Service, shippers, pilots, and fishermen who report sightings of Sargassum mats. For the response component, emergency response teams have been arranged in the coastal

communities consisting of a wide array of members from the village councils, community-based organizations, non-governmental organizations, fisherfolk groups, energy sector, hotel association, private sector organizations, youth groups, and the unemployment relief programme (URP). These groups would be trained on how to collect Sargassum. For the communication component, emphasis has been laid on a good communication system between the private sector, government agencies, the press, locals, and visitors. Additionally, a local Sargassum network has been set up for the wider public and coastal stakeholders that disseminates information such as satellite imagery and information on where clean beaches can be found. The Response plan furthermore contains components of research (p), monitoring (o), and to promote public education and awareness on the subject. The Response plan was reviewed by stakeholders who advised on investments in human and technological resources, forecasting and response systems, greater community involvement, and research into alternative uses (j).

Institutionally, the responsibility (l) of the response effort has been assumed greatly by T&T's government who established a National coordinating Committee to assist the Tobago House of Assembly (THA) and the Regional Corporations in the case of Trinidad. Like the other two cases, technical adaptation focused on the use of mechanical and manual clean up techniques. In *Spatial* terms, the Response plan emphasized on the importance that research institutes of T&T collaborate with other regional and international institutions. These regional collaborations would function to investigate the sources and massive increase in Sargassum, work on tracking technology, and learn from regional successes. Moreover, there is the desire to constantly monitor, learn and share knowledge on the regional level. In *Temporal* terms, it is acknowledged that a long-term plan is needed, but that scientific research (p) is essential to inform the development of such plan. Furthermore, the research component for the Response Plan is set to focus on broader topics i.e., seasonality, quantities, faunal species present, and the impacts on coastal ecosystems and coastal livelihoods. Consecutively, the research findings would be made available to the public through newspaper articles, information briefs and technical reports. Lastly, to be able to apply adaptive actions, there has been the need to provide urgent funding to assist in the operations of dealing with Sargassum. The phenomenon has required that a permanent fund (q) be put in place to deal with e.g., removal and disposal.



## 5. Comparison case-studies

The following chapter builds on the research findings of the previous chapter and compares valuable insights and findings between the case-studies. More specifically, comparison will be made between dominant frames for the categories of context, Sargassum and adaptation actions and also consider alignment between these categories for the case-studies.

As previous chapter has shown, the tourism sector is considered as one of the main economic pillars for all three of the case-studies. In the case of the DR, the relation between the economy and tourism was highlighted and the high dependency on tourism was a key concern. In this case, Sargassum imposed a threat directly to the economy of the entire island as the impact of tourism decline is felt on a country-wide level (Soto, 2015). In the case of Mexico, a much larger country with a much more diverse tourism market, it has been largely the coastal state of Quintana Roo that has felt the impacts in socio-economic terms of the massive Sargassum influx received on the Mexican-Caribbean coast (Ureste, 2019). Tourism has been labelled as the local economic engine and an important sector for Mexico's GDP (Zanolli, 2019). In the case of T&T, tourism has a different level of importance for Trinidad as for Tobago. Tobago relies much more on the tourism industry compared to Trinidad whose economy is largely reliant on the oil industry (Clyne, 2018). In consequence, the impact of cancellations of hotel bookings has been more drastic on the economy and local communities of Tobago compared to Trinidad.

For countries in the Caribbean, a region largely dependent on the tourism industry, it thus meant that a major economic contributor will be under continual threat of an environmental phenomenon of which it is largely unknown how long it would manifest or how much more severe it could get. It is therefore not that surprising that tourism obstruction and the management of the Sargassum influx was the main concern for the DR and Mexico. In the case of T&T the concerns were slightly different and the impact on the natural environment and communities was what raised more concern. Correspondingly, T&T's wider socio-economic settings were not only reliant on tourism but also on oil and the fishing industry and thus explains the larger concern for the consequences for the locals.

The second component was how Sargassum was mainly understood, largely framed, and mostly communicated through the online media sources. The Sargassum frames for the case studies were relatively similar. The frame *Human connection* was one dominant Sargassum frame that was present for each case study. More specifically, how Sargassum has affected local communities and how the phenomenon is linked as a cause of numerous human activities. The *Environmental frame* was another main frame for the DR and

T&T. Here the emphasis was on the negative impacts on the one hand, the positive environmental contributions on the other, as well as the natural environmental contributions to the phenomenon. For Mexico the other main frame was *Economic consequences*, highlighting the big economic impact that the phenomenon has had – in term of expenses and decline in tourism income – in comparison to the DR and T&T. In summary, considering the data on the three case studies, most online media content addressed Sargassum framed as a phenomenon that: (i) impacts local communities, (ii) the local environment, (iii) the economy, and (iv) has multiple interrelated causes of origin that have yet to be established. Nonetheless, all three case studies agree that the phenomenon is a consequence of a combination of human and natural causes. Yet, how to resolve or decrease the amount of Sargassum influx making its way into the Caribbean has been less clear. This topic remains controversial because it involves many difficult aspects that transcend national borders, not only in terms of geography, but also political and speak to characteristics of a global level.

The final component addressed how Adaptation was being applied in the three case studies. First of all, in *Technical* terms, all three case studies had similar approaches for collecting the Sargassum once it arrived on the coasts. This collection has been largely left to manual pickup solutions and/or heavy machinery like bulldozers. However, these cleaning methods have detrimental effects on the beaches for they remove a large quantity of sand and thus aggravate beach erosion (Agren, 2019). For that reason and others, the DR and Mexico have also experimented with collection barriers. This way they have expanded their collection capacity with the help of the barriers that retain the Sargassum while its collection happens by boats; whereas T&T did not have such capacity and relies only on the beach clean-up by hand or machinery. Consequently, the beaches of T&T are known to suffer more from loss of sand compared to the other two cases. Furthermore, there is little research on the environmental impacts that collecting the Sargassum in coastal waters might have since many marine animals use the mats for refuge and as a food source. Hence, environmental groups in Mexico have protested against the use of heavy machinery and the use of barriers for they cause harm to species that frequent the beaches (Partlow & Martinez, 2015).

On another note, there is the need to consider the availability of funds for possible adaptation measures. In the case of the DR and Mexico – countries that have larger tourism economies compared to T&T – the allocation of funds for improvement in adaptation mechanisms and research of proper collection techniques could be easier. For this reason, it is also that T&T indicated the need to create a special permanent fund – and Mexico has allocated a special budget to combat Sargassum as they have spent millions on cleanup costs (Kissoon, 2018; Mexia, 2019). Since Sargassum has been a huge economic burden for the countries, it is more

than understandable that they are inclined to search for ways the Sargassum can be put to good use. Many ideas have been proposed and mentioned in all three case studies. However, due to many uncertainties around the phenomenon e.g., concern about chemical contents of the seaweed and doubts about its continuation in the future, no concrete industrialization process has been assured (Molina & Mejia, 2019). There is therefore the notion that the reliance on regional partners is necessary for research on utilization possibilities and ideas for solutions.

The reliance on other stakeholders has been key in institutional terms. In particular, numerous alliances have been formed in several ways in the hopes that working together with other stakeholders would get them further along the way to understand, cope and combat the influx of Sargassum. In the case of the DR a special commission was set up to seek solutions to the problem. The DR's Sargassum protocol of 2015 was formulated by the Ministries of Tourism, Environment, and the National Association of Hotels and Tourism (Asonahores). The protocol showed the dominance of a limited number of actors and other stakeholders e.g., scientists, NGOs and other tourism businesses were not included. However, by 2019 there was recognition that more studies and public-private initiatives were needed and there was mentioning of more inclusion of civil and academic organizations.

In the case of Mexico, in 2015 it was reported that there was the formulation of several groups – including by the own communities – interested in addressing Sargassum troubles. However, the size of the country and zone impacted (i.e., 180.5 kilometers of beaches on Quintana Roo) could be a major reason that cooperation amongst stakeholders was and remains a challenge. For example, it took authorities of three levels of government – local, state and federal – to form the Inter-secretarial Commission to work on the matter (Velasco, 2015). By 2018, there was more cooperation amongst the relevant actors i.e., the three levels of government, the tourism sector, the academic sector and volunteers have been said to join forces to confront the issues at hand. Yet, the official worktable did only consist of the government and the business sector and not of all key stakeholders. By 2019, it was reported that efforts were still scattered, and that scientists, legislators, businessmen and citizens continued to work in isolation (Perez Ortega et al., 2019). After several years of having dealt with Sargassum, there was still no common vision, especially when it came to environmental matters. In other words, the institutional aspects and alliances for Mexico were not the strongest, perhaps even obstructing the progress that could have been made at the time. It was not until 2019, eight years after the first unusual influx of 2011, that a comprehensive and coordinated Action plan was formulated to deal with the reoccurring event.

In contrast, for T&T from early on there was clear signs of good working relations between key stakeholders: government agencies, private sector, the press, locals, and visitors. The local communities were especially for T&T a very important group in comparison to the DR and Mexico. Already since 2015 there was mentioning of working with communities to relieve those most affected. Vice versa, the communities were also very engaged in volunteering to clean the beaches from Sargassum. Furthermore, the establishment of a local Sargassum network, an emergency response team within the different coastal communities and the development of a public education and awareness programme indicate the high level of importance of including local communities in the building of the local Sargassum organizations (Institute of Marine Affairs, 2016). The higher levels of community involvement for T&T could be because of the geographical size and that the area that is most affected in T&T is directly the coastal villages compared to the DR and Mexico where mainly the influx arrived on touristic beaches covered with resorts. Nonetheless, T&T showed a great commitment of communication between stakeholders compared to other two who did not emphasize as much on creating strong communication networks. For the DR and Mexico, in the earlier years, there was a larger focus on the tourism industry, while locals were left behind in involvement and relief.

Accordingly, the importance of the main frames for *Context* and *Sargassum* were largely reflected in adaptive actions taken. For the DR and Mexico whose context was mainly concerning tourism and the economy in combination with the perception of Sargassum as human and natural causes affecting national income, the importance of the tourism sector for the economy was reflected back in actions taken. The main adaptive actions, based on the input of the government and hotel sector, were taken to prevent Sargassum from reaching the touristic beaches. In these cases, the effects on the natural environment and local communities were of secondary importance. In contrast, for T&T whose context was more diverse, and impact of natural environment and communities were main concerns, along with the frames of Sargassum as human and environmental aspect, resulted in adaptation actions of more involvement of a diverse range of local stakeholders. The importance of the tourism industry for all three case studies was very clear and adaptation of the tourism industry is happening in the DR and Mexico where they want to create awareness amongst tourists and invite them to learn about the phenomenon, but also by diversifying their products. For T&T there was no mentioning of any adaptive actions on behalf of the industry.

Another discussion point regarding adaptation mechanisms is the time frame that the case studies have considered in their Sargassum approaches in relation to continuous annual arrivals in the future. Mexico was the only case study that involved a temporal component in their strategy that considered actions in the short-, medium, and long-term. However, this approach evolved in 2019 after much criticism that after a few years

of massive influx the government was still approaching the influx on a year-to-year basis and actions to try to mitigate it were lacking (Carrere, 2018). Overall, planning ahead for a future with Sargassum remained scarce for all three case studies. Mexico's medium and long-term approaches involve the analysis of social and economic impacts; management and sustainable use; restoration; research, technological development and territorial planning; and international and cross-border relationship. This comprehensive Action plan is the furthest that any of the case studies has established to cope and adapt with the phenomenon until the time of this research. Furthermore, Mexico at some point was advocating to address the problem at its roots rather than to adapt to it. They have also taken it one step further and organized a summit for regional partners to discuss the issue at hand. Nonetheless, in terms of regional and international cooperation, concrete actions remain limited on behalf of the case-studies to achieve working relations with other Caribbean countries. Accordingly, bureaucracy may be playing a great role in this matter since Sargassum has been a subject that mainly governments have overseen and had decision-making power over. This facet, furthermore, can also affect the degree of innovation that this phenomenon has required but remains missing. Many destinations are not far from the same practices they applied when the phenomenon started.

Table 4 below, summarizes the most important characteristics that have come forward for the three case-studies. First of all, context is described to distinguish how each case stands individually. Second, adaptation in its many forms is listed to discern between different actions taken. Lastly, alignment between main concerns raised for the case studies and alleged adaptation actions is presented. The categories are distinguished from a scale of "low" to "very high" based on how these characteristics have developed until the last year studied, which in this case was 2019.

As can be seen from the table, diverse components are at different degrees per country. Nonetheless, considering *adaptive actions* that have been taken per country, Mexico scores "high" on each one of them, followed by the DR and lastly, T&T. Furthermore, evaluating if adaptive actions have been taken in relation to concerns raised, most actions have been taken concerning the preservation of the tourism industry in the case of the DR and Mexico. In the case of T&T adaptive actions have been "moderate" for the tourism industry, but "high" regarding community well-being. Accordingly, adaptation actions are dependent on availability of economic resources and funding available to deal with the problem. The difference in adaptive actions taken can be distinguished between a country like Mexico which has put substantial financial resources to cope with the problem, in comparison with T&T which is a much smaller country and where economic resources to put at the disposal of the Sargassum problem are scarcer.

Lastly, the alignment of adaptive actions with the environmental concerns raised, have been quite moderate on behalf of all three cases. Although the Sargassum phenomenon has showed to be detrimental to coastal marine species, the main concern has been for the state of the beaches and although in the DR and Mexico barriers have been introduced to prevent the Sargassum of accumulating on the beaches and decompose with its many negative consequences for many species, the collection of Sargassum mats in coastal waters has not proved to be safe for marine species inhabiting the mats. Leaving thus environmental matters to be last of the priorities.

	<b>DR</b>	<b>Mexico</b>	<b>T&amp;T</b>
<b>Context</b>			
<i>Sargassum influx volume</i>	High	Very high	High
<i>Tourism dependency</i>	High	High	Moderate (Tobago more than for Trinidad)
<i>Economic impact</i>	High	Very high	Moderate
<i>Environmental concern</i>	High	Low	High
<i>Concern for communities</i>	Moderate	High	Very high
<b>Adaptation actions</b>			
<i>Technical (barriers, mechanical &amp; manual pick-up)</i>	High	High	Moderate
<i>Institutional (collaborations; stake holder involvement)</i>	High	High	Very high
<i>Policy</i>	Moderate	High	Moderate
<i>Spatial (international approach)</i>	Moderate	High	Moderate
<i>Temporal (early detection &amp; monitoring; planning ahead)</i>	Moderate	High	Low
<b>Alignment adaptation actions</b>			
<i>Alignment environmental concerns and actions</i>	Moderate	Moderate	Low
<i>Alignment concern for communities and actions</i>	Low	Moderate	High
<i>Alignment tourism dependency and actions</i>	High	High	Moderate
<i>Funding</i>	Moderate	High	Low

Table 4. Summary important components per case-study

## 6. Discussion

The following chapter will elaborate on the interesting discussion points that came forward from the results chapter. Furthermore, the findings will be compared with similar research literature. Lastly, key components of this study such as the conceptual framework and methodology will be reflected upon.

The current study contributes to understanding of the role of framing in relation to uncertain environmental phenomena. Confirming points made by Juhola et al., (2011) and Salamat (2015) on the role of framing in the decision-making process and policy formulation, the study results have shown that for several years there was a lack of action on behalf of the countries because of the large uncertainties concerning the origins of the phenomenon. The little that was known, linked the phenomenon to larger environmental changes on a global level – leading to a wider scope of frames – and making the relatively small islands in the Caribbean feeling helpless in their approaches of finding complete solutions to the problem. In line with Dewulf's (2013) connection between framing and adaptation success, the notion that human induced climate change along other natural environmental characteristics are behind the causes of the massive influx, has influenced the notion of adaptation possibilities. For policy makers, moving into a new stage of better understanding of the phenomenon and its characteristics along with the possibilities of new frames, can mean the formulation of more adequate measures for adaptation.

In comparison to other environmental challenges, such as ocean acidification and sea level rise, Sargassum differs in its manifestation tempo and clear visibility of this manifestation, but shares that solutions are doubtful, scarce, and where there is little hopes of changes or improvements at the origin of the problems. Which means that adaptation is considered as the second-best option. Accordingly, this study contributes to the literature on understanding adaptive management to environmental changes in the Caribbean region in several ways. First, in line with the literature provided by Termeer et al., (2013) who identified the challenges to environmental adaptation, the Sargassum issue has shown that collaboration of interdependent actors is a key component that hinders or facilitates adaptation processes. Furthermore, the results have shown that the uncertainty around the Sargassum phenomenon makes it highly speculative and difficult to hold actors accountable for. For that reason, 'end-of-pipe' solutions have been the most sought after. Second, as Head (2014) specified how wicked problems require a distinct way of thinking from stakeholders, as well as long-term political and financial commitments, the Sargassum case has been a perfect example of the need to avoid thinking in the short-term but indicates that long-term thinking and planning is essential. It also highlighted the importance of having funds allocated to address the consequences of changing environmental conditions. Third, building on the study by Thomas et al., (2019) concerning adaptation

planning in the Caribbean, the Sargassum troubles have served as a crucial example that the region should pay more attention to: (i) the assessment of the climate hazards and risks as they are in a very vulnerable position as (mainly) islands; (ii) consecutively, there is the dire need to work towards identifying adaptation options in the particular context of each country; (iii) work towards the adaptation and diversification of particularly the tourism industry that can be very sensible to changes in environmental conditions or other worldwide phenomena such as a health pandemic.

Zooming out on the general approaches to address the Sargassum phenomenon, actions have been more accelerated compared to other environmental phenomena. Similar to the increasing presence of (more devastating) hurricanes in the WCR, the visibility of the massive influx and direct impact to crucial economic sectors have rushed Caribbean countries to summon up in regional meetings to discuss these matters. While other environmental phenomena that are less visible such as sea-level rise or sea temperature rise might have taken longer to get acknowledgement and get the attention of policy makers and governments. Because like hurricanes, Sargassum has become a recurring guest to the region, and it no longer is a matter of “if there will be influx this year”, but “how massive this influx will be”. Nonetheless, the Sargassum problem does share similar challenges as other environmental phenomena: lack of resources, trade-offs between safety and economic development, power relations, and conflicting interests of various coastal stakeholders concerning development of heavily used coastal zones (Oppenheimer et al., 2019).

This study is the first to address the topic of framing of the Sargassum phenomenon. Furthermore, it is also the first to do a comparative case-study interested in how the phenomenon and how adaptation has been understood. The analysis of multiple cases has resulted in broader understanding of the characteristics at play in the case of a transnational environmental problem like Sargassum in a region highly dependent on its coastal characteristics and resources. Although this research has shown how different countries have been affected in diverse forms, Sargassum in its larger extent has affected almost every country in the Caribbean in one way or another. It goes to show that countries cannot battle this phenomenon on their own, but need each other’s cooperation, knowledge and experiences if they want to make any progress in this predicament.

On a regional level, cooperation has been moving forward where online networks have provided the platform for sharing of research and latest updates on the topic. Conferences have been organized, yet policy outcomes compared to actual actions remain doubtful. Moreover, there is the dilemma on the economic gain that there is to be made of Sargassum as input for alternative resources, and the big business that there is already in place providing barriers and collective fleets as solutions to the problem when the mats reach coastal waters. Many concerns have been raised regarding the safety of such barriers since it can disturb the



natural flow of marine animals and their environment. Not to mention the impact of collecting these mats with conveyor belts at sea will have on the marine species living of the Sargassum mats. These all have been issues that have been given second priority in the pursuit of preventing the mats of reaching the coasts and certainly, it is in the interest of these businesses that Sargassum continues to be a recurring event.

Preventing the Sargassum blooms of occurring at the massive scale that is has been happening is tricky. Although scientists are coming closer to finding the definite reasons for these blooms, preventing them would be a whole new ball game encompassing global politics, large-scale industries, many other summits, conferences and perhaps it will take years before results of any action taken can be witnessed. Perhaps at the moment, and years to come, the best approach to be taken is the one that would least harm the environment and coastal industries of which communities depend on. In the meantime, other alternatives have been proposed for example, of sinking the mats to the bottom of the ocean. This approach raises of course a lot of concerns, including the dilemma of losing the function of the Sargassum mats as a natural Carbon sink.

Concerning the conceptual framework that guided this study, it needs to be mentioned that it had some limitations. First of all, this study assumed that the combination of context characteristics and Sargassum framing would help explain the consecutive adaptation approaches. Yet, context and framing of Sargassum cannot always steer adaptation equally. The DR and Mexico have served as examples that context i.e., being largely tourism dependent, will greatly impact the adaptive approaches chosen. Likewise, the study by Manuel-Navarrete (2011) also claimed that adaptation to hurricanes was affected by visions of development and governance structures implying that many times, context will overarch the environmental problem and its consequences. Again highlighting the reality of short-term thinking of development and economic gain while environmental changes are given less importance.

The methodology applied throughout this research did also have some limitations. The study was built upon a set of pre-defined frames adopted from previous studies on framing of climate change. The set of pre-defined frames, to a certain extent, did narrow down what was being looked for in the data. Furthermore, the data that was analyzed was limited to online news sources, in other words, the study did entail an analysis that took place at a distance and not in situ. Concerning the quality of the results this means that conclusions were drawn on secondary data and the research findings were not confirmed by means of for example interviews with relevant stakeholders. Moreover, the at a distance analysis of the case studies resulted in a very systemic way of analyzing the data that was available online and has therefore, in terms of a qualitative analysis, been less detailed than otherwise could have been possible.

## 7. Conclusion

The final chapter of this thesis will draw upon the main conclusions of this research and answer the research questions. Lastly, a few recommendations for future research will be provided.

This research had as intention to put a spotlight on how the Caribbean region is doing on the spectrum of environmental change identification, impact and adaptation mechanisms and policies by focusing especially on the recent Sargassum phenomenon. It furthermore addressed the concept of framing and its role in understanding an environmental change phenomenon and the consecutive adaptive actions taken.

This thesis has focused on the following research question: “How does framing of environmental problem Sargassum in different Caribbean countries align with adaptive solutions?” This research question was addressed by focusing on components believed to be key in the understanding of adaptation to an environmental phenomenon: *situational context*, *environmental phenomenon framing*, and *adaptation management*. To understand the regional situation in the WCR, three different case-studies were chosen: the DR, Mexico and Trinidad and Tobago.

To answer the main question, sub-questions were formulated. The first question addressed how context, the Sargassum problem and adaptation were framed in the case-studies. For all three cases the tourism industry was considered a very important contributor to the country’s economy and thus made the Sargassum problem a critical to deal with for the sake of the economic implications for the local economy and job market. The Sargassum phenomenon was understood mainly in terms of the environment, the economy, and humans i.e., local communities. Adaptation was largely looked at from the point of technical and institutional actions.

The second question was concerned with the impact of framing Sargassum in a certain way would have implications on alignment with adaptive actions. The implication of the frames surrounding the Sargassum phenomenon have indicated that adaptive mechanisms are largely formulated along the perceptions of what is thought to be the most important aspects to attend to. The analysis concluded that the uncertainty surrounding the subject impeded for effective action to be taken at the start of the phenomenon. Additionally, the importance of the contextual factors of key economic industries dependent on the coasts were put as a priority in adaptive actions. Moreover, the importance of research and economic resources were highlighted as means that could fill in gaps of knowledge and facilitate the adaptation process.

The final question addressed the differences and similarities between the cases’ context, Sargassum framing and alignment with adaptive actions taken. For the DR and Mexico, great emphasis was placed on the

stewardship of the tourism industry for its economic significance and their adaptation actions and key actors involved in the process did reflect that this was the priority for these case studies. For T&T with a more diverse economy, although tourism did also play an important role, there were also other matters that were considered important such as the impacts on fishing activities, and the negative impact on coastal villages and the environment.

Overall, the study contributed to the literature on framing for understanding and identifying the impacts of environmental change and the identification and appraisal of a range of adaptation possibilities in the Caribbean context (Thomas et al., 2019). However, framing only impacts adaptation actions partially, there is also the need for research, for funding, for commitment between stakeholder from a local to a global level to wanting to address an environmental problem.

This thesis paves the way to another level of comprehension of the Sargassum phenomenon – a subject that still misses a lot of understanding regarding the socio-economic and governance arenas. It would be valuable to conduct likewise research with another set of pre-defined frames or performing a content analysis of the data and formulating frames based on this initial data. Furthermore, it would be interesting to perform similar research with the added components of interviewing important stakeholders e.g., tourism industry, government, local communities, NGOs and research institutions, that would help facilitate understanding on adaptation. It would be interesting to compare the different perspectives of the stakeholders and understand how they view that adaptation to the Sargassum phenomenon could or should take place in the near future and in the long-term. Another interesting research will be the study of one specific country. This will allow a more in-depth understanding of the characteristics at play and will allow a more recent comparison of framings and adaptation actions.

Lastly, this thesis started with an epigraph touching upon the lessons that nature could teach us if we would only care to stop, look, and listen. In the case of Sargassum, it inevitably sparks the questions of: What is Sargassum trying to say to us? Trying to teach us? One of the articles of the DR included in this study headlined: “Sargassum in the Caribbean: a cry to save the oceans?” The article concludes by stating: “Everything indicates that sargassum is a form of the ocean shouting: save me!” (Vargas, 2019). Yet this new phenomenon (by now turning into the new normal) is not alarming enough to invoke proper attention to the problem and incentivize actions, but instead a future with Sargassum is what is most likely to happen if our oceans are not better looked after.

## References

- Adler, E., & Clark, R. (2007). *How it's done: An invitation to social research*. Cengage Learning.
- Agren, D. (2019, June 28). *Seaweed invasion threatens tourism in Mexico's beaches as problem worsens*. The Guardian. Retrieved on February 26, 2021, from <https://www.theguardian.com/world/2019/jun/28/mexico-seaweed-invasion-tourism-caribbean-beaches>
- Animal Politico (2019, June 24). *Sargazo en Quintana Roo se ha magnificado para afectar al nuevo gobierno: AMLO*. Retrieved on December 06, 2020, from <https://www.animalpolitico.com/2019/06/sargazo-quintana-roo-amlo-marina-invertiran-52-mdp/>
- Aswani, S., Vaccaro, I., Abernethy, K., Albert, S., & Fernández-López De Pablo, J. (2015). Can Perceptions of Environmental and Climate Change in Island Communities Assist in Adaptation Planning Locally? *Environmental Management*, 56, 1487–1501. <https://doi.org/10.1007/s00267-015-0572-3>
- Carrere, M. (2018, September 13). *El sargazo: el alga que amenaza contrasforar las aguas del Caribe en pantanos verdosos*. Mongobay. Retrieved on March 1, 2021, from <https://es.mongabay.com/2018/09/mexico-sargazo-en-aguas-del-caribe-centroamerica/>
- Charles, A. (2012, July). People, oceans and scale: Governance, livelihoods and climate change adaptation in marine social-ecological systems. *Current Opinion in Environmental Sustainability*. <https://doi.org/10.1016/j.cosust.2012.05.011>
- CIA (2020). *The World Factbook*. Retrieved May 06, 2020, from <https://www.cia.gov/library/publications/the-world-factbook/geos/mx.html>
- Clingerman, F., & Ehret, V. M. (2013). Hope and fear: The theological side of framing environmental change. *Ethics, Policy & Environment*, 16(2), 152-155.
- Clyne, K. (2018, May 10). *The return of sargassum*. Trinidad and Tobago Newsday. Retrieved February 25, 2021, from <https://newsday.co.tt/2018/05/10/the-return-of-sargassum/>
- Cochrane, K., De Young, C., Soto, D., & Bahri, T. (2009). Climate change implications for fisheries and aquaculture. *FAO Fisheries and aquaculture technical paper*, 530, 212.
- Cox, S., H.A. Oxenford and P. McConney. (2019). *Summary report on the review of draft national sargassum plans for four countries Eastern Caribbean*. Report prepared for the Climate Change Adaptation in the Eastern Caribbean Fisheries Sector (CC4FISH) Project of the Food and Agriculture Organization (FAO) and the Global Environment Facility (GEF). Centre for Resource Management and Environmental Studies, University of the West Indies, Cave Hill Campus, Barbados. 20 pp
- Cramer, C. M. (2008). *The framing of climate change in three daily newspapers in the Western Cape Province of South Africa*. Retrieved from <http://scholar.sun.ac.za/handle/10019.1/2204>
- Dewulf, A., Gray, B., Putnam, L., Lewicki, R., Aarts, N., Bouwen, R., & Van Woerkum, C. (2009). Disentangling approaches to framing in conflict and negotiation research: A meta-paradigmatic perspective. *Human relations*, 62(2), 155-193.

- Dewulf, A. (2013). Contrasting frames in policy debates on climate change adaptation. *Wiley Interdisciplinary Reviews: Climate Change*, 4(4), 321-330.
- Doyle, E. and Franks, J. (2015). *Sargassum Fact Sheet*. Retrieved May 7, 2020, from <http://oceancurrents.rsmas.miami.edu/>
- Encyclopaedia Britannica (1998). *Trinidad and Tobago*. Retrieved May 7, 2020, from <https://www.britannica.com/place/Trinidad-and-Tobago>
- Encyclopaedia Britannica (2000). *Dominican Republic and Haiti*. Retrieved May 7, 2020, from <https://www.britannica.com/place/Dominican-Republic>
- Encyclopaedia Britannica (2007). *Mexico*. Retrieved May 7, 2020, from <https://www.britannica.com/place/Mexico>
- Ferree, M. M., Gamson, W. A., Rucht, D., & Gerhards, J. (2002). *Shaping abortion discourse: Democracy and the public sphere in Germany and the United States*. Cambridge University Press.
- Fine, G. A., & Elsbach, K. D. (2000). Ethnography and experiment in social psychological theory building: Tactics for integrating qualitative field data with quantitative lab data. *Journal of Experimental Social Psychology*, 36(1), 51-76.
- Fleming, A., Rickards, L., & Dowd, A. M. (2015). Understanding convergence and divergence in the framing of climate change responses: An analysis of two wine companies. *Environmental Science & Policy*, 51, 202-214.
- Fuentes, G. (2015, December 10). *#Voices2Paris – Sargazo y cambio climatico en el Caribe*. UNDP Mexico. Retrieved on December 6, 2020, from <https://www.mx.undp.org/content/mexico/es/home/presscenter/articles/2015/12/10/sargazo-y-cambio-clim-tico-en-el-caribe.html>
- Fuller, J. (2019). *Sargassum certainty*. Cayman Compass. Retrieved on March 5, 2021, from <https://www.caymancompass.com/2019/05/01/sargassum-certainty/>
- Franks, J. S., Johnson, D. R., Ko, D. S., Johnson, D. R., & Ko, D. S. (2016). Pelagic Sargassum in the Tropical North Atlantic. *Gulf and Caribbean Research*, 27(1), 6–11. <https://doi.org/10.18785/gcr.2701.08>
- Gouvêa, L. P., Assis, J., Gurgel, C. F. D., Serrão, E. A., Silveira, T. C. L., Santos, R., ... Horta, P. A. (2020). Golden carbon of Sargassum forests revealed as an opportunity for climate change mitigation. *Science of the Total Environment*. <https://doi.org/10.1016/j.scitotenv.2020.138745>
- Gonzalez, N., & Wiarda, H. (n.d.). *Dominican Republic*. Retrieved May 7, 2020, from <https://www.britannica.com/place/Dominican-Republic>
- Gower, J., Young, E., & King, S. (2013). Satellite images suggest a new Sargassum source region in 2011. *Remote Sensing Letters*, 4(8), 764–773.
- Harrould-Kolieb, E. R. (2020). Framing ocean acidification to mobilise action under multilateral environmental agreements. *Environmental Science & Policy*, 104, 129-135.
- Head, B. W. (2014). Evidence, uncertainty, and wicked problems in climate change decision making in Australia. *Environment and Planning C: Government and Policy*, 32(4), 663–679. <https://doi.org/10.1068/c1240>

- Incropera, F.P., (2015). *Climate Change: a Wicked Problem - Complexity and Uncertainty at the Intersection of Science, Economics, Politics and Human Behaviour*. Cambridge University Press, Cambridge.
- Institute of Marine Affairs (2016). *National Sargassum Response Plan*. Hilltop Lane, Chaguaramas, Trinidad.
- IPCC, 2012: Summary for Policymakers. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.
- Jentoft, S., van Son, T. C., & Bjørkan, M. (2007). Marine protected areas: a governance system analysis. *Human Ecology*, 35(5), 611-622.
- Johns, E. M., Lumpkin, R., Putman, N. F., Smith, R. H., Muller-Karger, F. E., T. Rueda-Roa, D., ... Werner, F. E. (2020). The establishment of a pelagic Sargassum population in the tropical Atlantic: Biological consequences of a basin-scale long distance dispersal event. *Progress in Oceanography*, 182, 102269. <https://doi.org/10.1016/j.pocean.2020.102269>
- Juhola, S., Keskitalo, E. C. ., & Westerhoff, L. (2011). Understanding the framings of climate change adaptation across multiple scales of governance in Europe. *Environmental Politics*, 20(4), 445–463. <https://doi.org/10.1080/09644016.2011.589571>
- Karetnick, J. (2019, August 18). *How To Handle a Massive Seaweed Invasion? Yucatan Towns Get Creative*. Retrieved October 16, 2020, from <https://www.npr.org/sections/thesalt/2019/08/18/751250934/how-to-handle-a-massive-seaweed-invasion-yucat-n-towns-get-creative>
- Kissoon, C. (2018, April 18). *East coast tourism crippled by seaweed*. Trinidad Daily Express. Retrieved on February 26, 2021, from [https://trinidadexpress.com/news/east-coast-tourism-crippled-by-seaweed/article\\_c2d49a44-430c-11e8-81cb-3b3e9d3dd915.html](https://trinidadexpress.com/news/east-coast-tourism-crippled-by-seaweed/article_c2d49a44-430c-11e8-81cb-3b3e9d3dd915.html)
- Laffoley, D. D. A., Roe, H. S. J., Angel, M. V., Ardron, J., Bates, N. R., Boyd, I. L., ... & Conte, M. H. (2011). *The Protection and Management of the Sargasso Sea*. Sargasso Sea Alliance.
- Lakoff, G. (2010). Why it matters how we frame the environment. *Environmental communication*, 4(1), 70-81.
- Lane, D., Clarke, C. M., Forbes, D. L., & Watson, P. (2013). The Gathering Storm: managing adaptation to environmental change in coastal communities and small islands. *Sustainability Science*, 8(3), 469–489. <https://doi.org/10.1007/s11625-013-0213-9>
- Lapointe, B. E., West, L. E., Sutton, T. T., & Hu, C. (2014). Ryther revisited: nutrient excretions by fishes enhance productivity of pelagic Sargassum in the western North Atlantic Ocean. *Journal of Experimental Marine Biology and Ecology*, 458, 46-56.
- Lebel, L., Käkönen, M., Dany, V., Lebel, P., Thuon, T., & Voladet, S. (2018). The framing and governance of climate change adaptation projects in Lao PDR and Cambodia. *International Environmental Agreements: Politics, Law and Economics*, 18(3), 429-446.

- Lehtonen, A., Salonen, A., Cantell, H., & Riuttanen, L. (2018). A pedagogy of interconnectedness for encountering climate change as a wicked sustainability problem. <https://doi.org/10.1016/j.jclepro.2018.07.186>
- Manuel-Navarrete, D., Pelling, M., & Redclift, M. (2011). Critical adaptation to hurricanes in the Mexican Caribbean: Development visions, governance structures, and coping strategies. *Global Environmental Change*, 21(1), 249-258.
- Maréchal, J. P., Hellio, C., & Hu, C. (2017). A simple, fast, and reliable method to predict Sargassum washing ashore in the Lesser Antilles. *Remote Sensing Applications: Society and Environment*, 5(May 2016), 54–63. <https://doi.org/10.1016/j.rsase.2017.01.001>
- Mendez-Tejeda, R., & Rosado Jimenez, G. A. (2019). Influence of climatic factors on Sargassum arrivals to the coasts of the Dominican Republic. *Joexiaurnal of Oceanography and Marine Science*, 10(2), 22-32.
- Mexia, I. (2019, May 29). *Sargazo provoca caídas de la ocupación del Caribe Mexicano de hasta un 5%*. Agent Travel. Retrieved on December 6, 2020, from <https://www.agenttravel.es/noticia-034352-El-sargazo-provoca-caidas-de-la-ocupacion-hotelera-en-el-Caribe-mexicano-de-hasta-un-5.html>
- Milledge, J. J., & Harvey, P. J. (2016). Golden Tides: Problem or golden opportunity? The valorisation of Sargassum from beach inundations. *Journal of Marine Science and Engineering*. MDPI AG. <https://doi.org/10.3390/jmse4030060>
- Middelbeek, L., Kolle, K., Verrest, H., & Verrest, H. (2014). Built to last? Local climate change adaptation and governance in the Caribbean-The case of an informal urban settlement in Trinidad and Tobago. *Urban Climate*, 8, 138–154. <https://doi.org/10.1016/j.uclim.2013.12.003>
- Molina, T. & Mejia, M. (2019, Junio 08). *Fertilizantes, platos, hundirlo... soluciones al sargazo en el Caribe*. Diario Libre. Retrieved on February 26, 2019, from <https://www.diariolibre.com/actualidad/medioambiente/fertilizantes-platos-hundirlo-soluciones-al-sargazo-en-el-caribe-ND13016931>
- Montevago, J. (2020, February 21). *Arrival of Sargassum Seaweed is inevitable, but forecast predicts less this year*. Retrieved on May 8, 2020, from <https://www.travelmarketreport.com/articles/Arrival-of-Sargassum-Seaweed-is-Inevitable-But-Forecast-Predicts-Less-This-Year>
- Morton, T. A., Rabinovich, A., Marshall, D., & Bretschneider, P. (2011). The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications. *Global Environmental Change*, 2(1), 103–109.
- Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the national academy of sciences*, 107(51), 22026-22031.
- Mossler, M. V., Bostrom, A., Kelly, R. P., Crosman, K. M., & Moy, P. (2017). How does framing affect policy support for emissions mitigation? Testing the effects of ocean acidification and other carbon emissions frames. *Global environmental change*, 45, 63-78.

- Nisbet, M. C. (2010). Communicating Climate Change: Why Frames Matter for Public Engagement. *Environment: Science and Policy for Sustainable Development*, 51(2), 12–23.  
<https://doi.org/10.3200/ENVT.51.2.12-23>
- Oppenheimer, M., Glavovic, B.C. , Hinkel, J., van de Wal, R., Magnan, A.K., Abd-Elgwad, A., Cai, R., Cifuentes-Jara, M., DeConto, R.M., Ghosh, T., Hay, J., Isla, F., Marzeion B., Meyssignac, B., and Sebesvari, Z. (2019) Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press
- Palerm, A., Bamford, H., Griffin, E., Meyer, M., Bernstein, M., Cline, H. & Willey, G. (2020, April 24). Mexico. Retrieved May 7, 2020, from <https://www.britannica.com/place/Mexico>
- Paraguay-Delgado, F., Carreño-Gallardo, C., Estrada-Guel, I., Zabala-Arceo, A., Martinez-Rodriguez, H. A., & Lardizábal-Gutierrez, D. (2020). Pelagic Sargassum spp. capture CO2 and produce calcite. *Environmental Science and Pollution Research*, 1–7. <https://doi.org/10.1007/s11356-020-08969-w>
- Partlow, J. & Martinez, G. (2015, October 28). *Mexico deploys its navy to face its latest threat: Monster seaweed*. Retrieved on February 26, 2021, from [https://www.washingtonpost.com/world/the\\_americas/mexico-deploys-its-navy-to-face-its-latest-threat-monster-seaweed/2015/10/28/cea8ac28-710b-11e5-ba14-318f8e87a2fc\\_story.html](https://www.washingtonpost.com/world/the_americas/mexico-deploys-its-navy-to-face-its-latest-threat-monster-seaweed/2015/10/28/cea8ac28-710b-11e5-ba14-318f8e87a2fc_story.html)
- Perez Ortega, R., Toche, N. & Vidal Valero, M. (2019, August 16). ‘It’s an ecological disaster’: the sargassum crisis in Mexico. *The New York Times*. Retrieved December 05, 2020, from <https://www.nytimes.com/es/2019/08/16/espanol/america-latina/sargazo-playas-mexico.html>
- Peters, K. (2018). Living with the Wicked Problem of Climate Change. *Zygon*, 53(2), 427-442.
- Petchary (2016, June 5). *Map of the Wider Caribbean Region*. Retrieved May 05, 2020, from <https://petchary.wordpress.com/2016/06/05/the-wonderful-oceans-that-surround-us-world-oceans-day/figure1/>
- Romsdahl, R. J., Kirilenko, A., Wood, R. S., & Hultquist, A. (2017). Assessing national discourse and local governance framing of climate change for adaptation in the United Kingdom. *Environmental Communication*, 11(4), 515-536.
- Salamat, M. R. (2015, August). The power of framing and response to global environmental challenges: the case of climate change. In *Natural Resources Forum* (Vol. 39, No. 3-4, pp. 153-156).
- Shah, K. U., Dulal, H. B., & Awojobi, M. T. (2020). Food Security and Livelihood Vulnerability to Climate Change in Trinidad and Tobago. In *Food Security in Small Island States* (pp. 219-237). Springer, Singapore.
- Smit, B., & Pilifosova, O. (2003). Adaptation to climate change in the context of sustainable development and equity. *Sustainable Development*, 8(9), 9.



- Soto, W. (2015, December 4). *Sargazo, el primer embate del cambio climático a RD*. El Dinero. Retrieved February 25, 2021, from <https://www.eldinero.com.do/18473/sargazo-el-primer-embate-del-cambio-climatico-a-republica-dominicana/>
- Spence, A., & Pidgeon, N. (2010). Framing and communicating climate change: The effects of distance and outcome frame manipulations. *Global Environmental Change*, 20(4), 656-667.
- Termeer, C., Dewulf, A., & Breeman, G. (2013). Governance of wicked climate adaptation problems. In *Climate change governance* (pp. 27-39). Springer, Berlin, Heidelberg.
- Thomas, A., Shooya, O., Rokitzki, M., Bertrand, M., & Lissner, T. (2019). Climate change adaptation planning in practice: insights from the Caribbean. *Regional Environmental Change*, 19(7), 2013-2025.
- UNEP (n.d.). Wider Caribbean. Retrieved May 05, 2020, from <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/regional-seas-programmes/wider>
- UNWTO (2020, January 15). Country Profile – Inbound Tourism. Retrieved May 06, 2020, from <https://www.unwto.org/country-profile-inbound-tourism>
- Ureste, M. (2019, July 16). *Agencias de viajes y el gobierno estatal minimizan la crisis de sargazo para no perder turistas*. Animal Político. Retrieved February 25, 2021, from <https://www.animalpolitico.com/2019/07/agencias-viajes-gobierno-quintana-roo-crisis-sargazo-turistas/>
- Vargas, R. (2019, June 07). *Sargazo en el Caribe ¿grito para salvar los océanos?* UNDP Republica Dominicana. Retrieved April 11, 2019, from [https://www.do.undp.org/content/dominican\\_republic/es/home/blog/2019/sargazo-en-el-caribe--grito-para-salvar-los-oceanos-.html](https://www.do.undp.org/content/dominican_republic/es/home/blog/2019/sargazo-en-el-caribe--grito-para-salvar-los-oceanos-.html)
- Velasco, A. (2015, July 28). *Sargazo invade el Caribe: ¿Qué es y cómo se combate?* El Financiero. Retrieved December 04, 2020, from <https://www.elfinanciero.com.mx/nacional/sargazo-invade-el-caribe-que-es-y-como-se-combate>
- Wang, M., & Hu, C. (2016). Mapping and quantifying Sargassum distribution and coverage in the Central West Atlantic using MODIS observations. *Remote sensing of environment*, 183, 350-367.
- Wang, M., Hu, C., Barnes, B. B., Mitchum, G., Lapointe, B., & Montoya, J. P. (2019). The great Atlantic Sargassum belt. *Science*, 365(6448), 83-87.
- Watts, D., Brereton, B., & Robinson, A., (2020, April 26). Trinidad and Tobago. Retrieved May 07, 2020, from <https://www.britannica.com/place/Trinidad-and-Tobago>
- Webster, S. & Lima, A. (2019, June 10). How Mexico became a top global destination for modern tourism. Retrieved May 06, 2020, from <https://labs.ebanx.com/en/articles/travel/how-mexico-became-a-top-global-destination-for-modern-tourism/>
- Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review*, 15(1), 45-55.

Zanoli, L. (2019, April 24). *Why seaweed is strangling Mexican tourism, and how science could help*. MIT Technology review. Retrieved February 25, 2021, from <https://www.eldinero.com.do/18473/sargazo-el-primer-embate-del-cambio-climatico-a-republica-dominicana/>

# Appendix

## Appendix I: Overview of the coverage of frames per country per year

### A. Coverage of Frames for the Dominican Republic

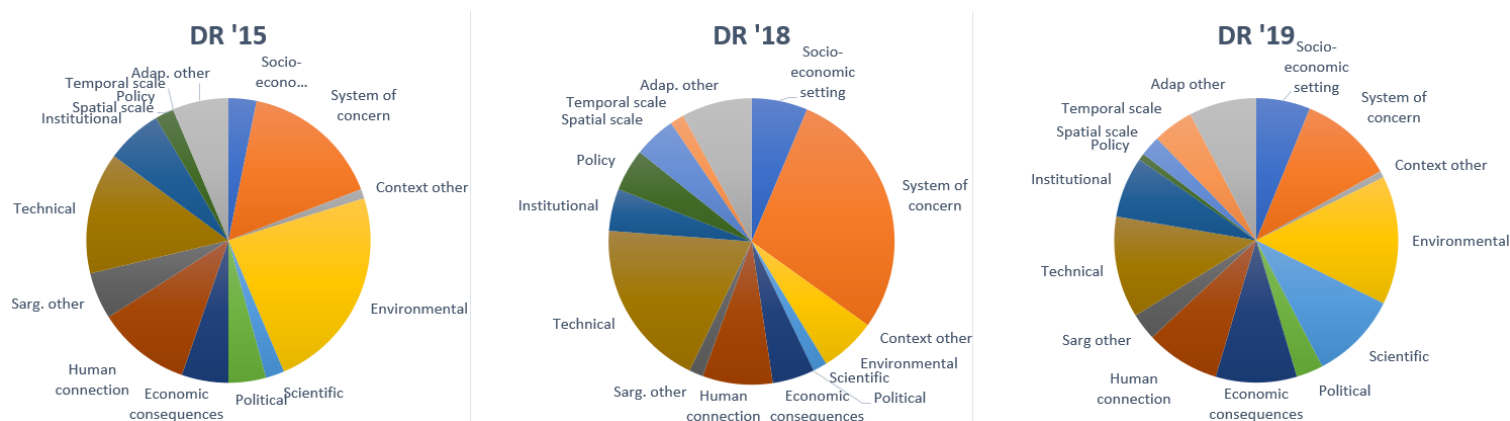


Figure 20. Division of the frame categories per year for the Dominican Republic

2015	2018	2019			
Environmental	22%	System of concern	29%	Environmental	15%
Technical	16%	Technical	19%	Technical	12%
System of Concern	15%	Human connection	8%	System of concern	11%
Human connection	10%	Adap. other	8%	Scientific	10%
Institutional	9%	Socio-economic setting	6%	Economic	9%
Adap. other	6%	Environmental	6%	Human connection	8%
Economic	5%	Economic	5%	Adap other	8%
Sarg. other	5%	Institutional	5%	Institutional	7%
Political	4%	Policy	5%	Socio-economic setting	6%
Policy	4%	Spatial scale	5%	Temporal scale	5%
Socio-economic setting	3%	Scientific	2%	Political	3%
Scientific	2%	Sarg. other	2%	Sarg other	3%
Context other	1%	Temporal scale	2%	Spatial scale	2%
Temporal scale	1%	Context other	0%	Context other	1%
Spatial scale	0%	Political	0%	Policy	1%

Table 5. Frame coverage in percentage per year for the DR

## B. Coverage of Frames for Mexico

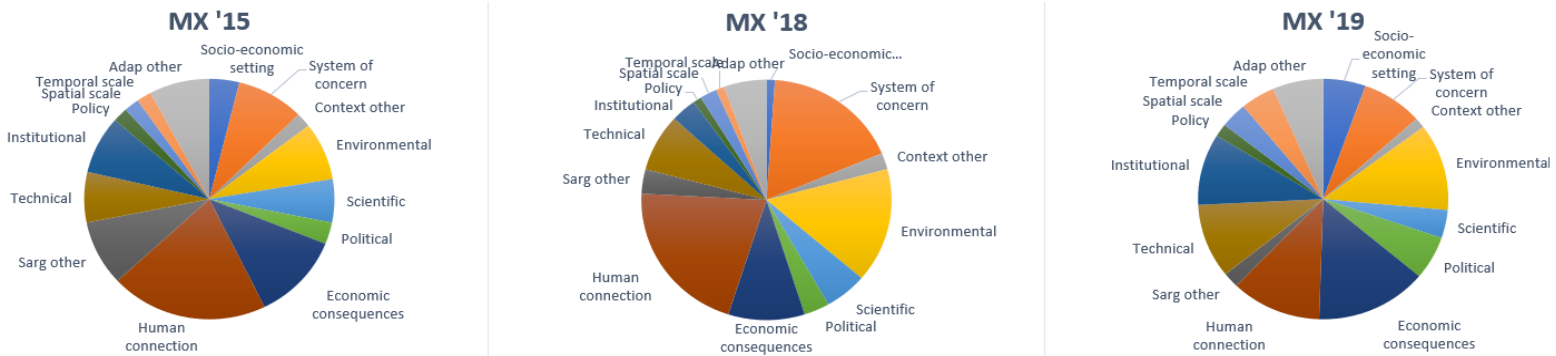


Figure 21. Division of the frame categories per year for Mexico

2015	2018	2019			
Human connection	20%	Human connection	21%	Economic	14%
Economic	12%	System of concern	18%	Environmental	12%
System of concern	9%	Environmental	15%	Human connection	12%
Sarg. other	9%	Economic	10%	Technical	10%
Environmental	8%	Technical	8%	Institutional	10%
Institutional	8%	Scientific	5%	System of concern	8%
Adap. other	8%	Adap other	5%	Adap other	7%
Technical	7%	Political	3%	Political	6%
Scientific	6%	Sarg other	3%	Socio-economic setting	5%
Socio-economic setting	4%	Institutional	3%	Temporal scale	4%
Political	3%	Context other	2%	Scientific	4%
Context other	2%	Spatial scale	2%	Spatial scale	3%
Policy	2%	Socio-economic setting	1%	Sarg other	2%
Spatial scale	2%	Policy	1%	Policy	2%
Temporal scale	2%	Temporal scale	1%	Context other	1%

Table 6. Frame coverage in percentage per year for Mexico

### C. Coverage of Frames for Trinidad & Tobago

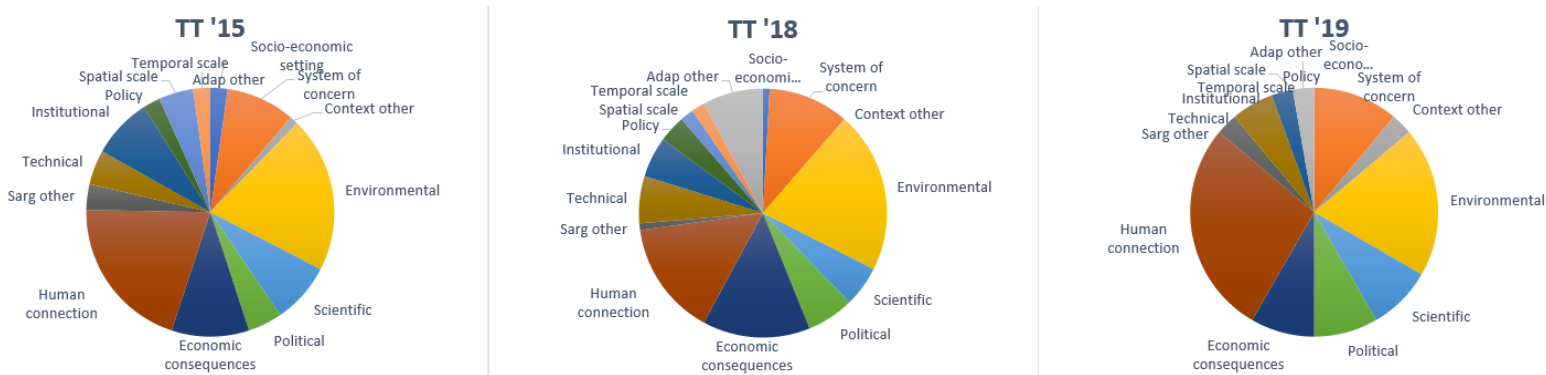


Figure 22. Division of the frame categories per year for Trinidad & Tobago

2015	2018	2019			
Environmental	20%	Environmental	21%	Human connection	28%
Human connection	20%	Human connection	15%	Environmental	19%
Economic consequences	10%	Economic consequences	14%	System of concern	11%
System of concern	9%	System of concern	11%	Scientific	8%
Scientific	8%	Adap other	8%	Political	8%
Institutional	8%	Political	6%	Economic consequences	8%
Political	4%	Technical	6%	Technical	6%
Technical	4%	Scientific	5%	Context other	3%
Spatial scale	4%	Institutional	5%	Sarg other	3%
Sarg other	3%	Policy	4%	Institutional	3%
Socio-economic	2%	Spatial scale	2%	Adap other	3%
Policy	2%	Temporal scale	2%	Socio-economic	0%
Temporal scale	2%	Socio-economic	1%	Policy	0%
Context other	1%	Sarg other	1%	Spatial scale	0%
Adap other	0%	Context other	0%	Temporal scale	0%

Table 7. Frame coverage in percentage per year for T&T