



# Master thesis

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## Sargassum seaweed in Guadeloupe: a public health concern

An interview study in Guadeloupe, French West Indies

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<b>Titel</b>	Sargassum seaweed in Guadeloupe: a public health concern. <i>An interview study in Guadeloupe, French West Indies</i>
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## Sammanfattning

**Bakgrund** Strömmar av brunalgen sargassum har drabbat Karibien i flera år, särskilt påtagligt det senaste decenniet, sedan år 2011. Den överväldiga mängden sargassum har förknippats med klimatförändringar och utsläpp av gödningsmedel i havet. Sargassum har påvisats orsaka negativa hälsoeffekter för människan, bland annat yrsel, illamående, andningssvårigheter och eksem.

**Syfte** Syftet i studien var att utforska hur strömmar av brunalgen sargassum påverkar invånarnas livsstil och hälsa på ön Guadeloupe, samt vilka strategier som används för att hantera sargassum i praktiken.

**Metod** Som datainsamlingsmetod har tio informanter intervjuats genom semistrukturerade intervjuer. Studiens informanter har bestått av icke-statliga organisationer, verksamheter inom hälso- och sjukvård, samt organisationer inom turism och maritima sektorn.

**Resultat** Resultatet påvisar en ökad mängd oro av hälsoeffekterna kopplade till brunalgen samt ett kunskapsgap då det kommer till hälsoinformation om sargassum.

**Slutsats** Studiens slutsats är att mer information behövs om hälsoeffekterna av sargassum och att hälsolitteracitet bland invånarna bör utvecklas. Även effektivare åtgärder för att göra sig av med brunalgen är nödvändiga. Därtill kan strömmar av sargassum anses vara ett hinder för destinationen att arbeta för Förenta nationernas globala mål nummer tre – *god hälsa och välbefinnande*, mål tretton – *bekämpa klimatförändringarna*, samt mål fjorton – *hav och marina resurser*.

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## Abstract

**Background** Waves of the brown algae sargassum have been floating over the Caribbean for years, but most noticeably during the last decade, since 2011. The overwhelming amount of sargassum has been linked to climate change and the release of fertilisers into the ocean. Sargassum has been shown to cause negative health effects, including dizziness, nausea, breathing difficulties, and eczema.

**Objective** The purpose of the study has been to explore how Guadeloupe is handling the seaweed sargassum, and how inhabitants' health and lifestyle are affected.

**Method** As a data collection method, ten informants were interviewed through semi-structured interviews. The informants have consisted of non-governmental organisations, the health care sector and organisations within the tourism and marine sector.

**Results** The results show an increased amount of concern about the health effects linked to the brown algae sargassum and a knowledge gap when it comes to health information about the brown algae.

**Conclusion** The study's conclusion is that more information is needed about the health effects of sargassum, health literacy among the inhabitants requires development, and more effective measures to get rid of brown algae are necessary. In addition, waves of sargassum can be an obstacle for the destination to work for United Nation's global goals number three - *good health and well-being*, goal thirteen - *climate action*, and goal fourteen - *life below water*.

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*Le Gosier, 18.10.2023*

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## Introduction

Sargassum seaweed is a type of large brown algae that floats in island-like mats and mostly never attaches to the seabed (Préfet de la région Guadeloupe, 2022). The first sights of sargassum mats floating around in the North Atlantic Ocean were spotted back in the 15th century. Thus, sargassum mats have existed for a long time and is not considered a new phenomenon. However, the spreading and growth of sargassum mats have changed during the last decade. From being compact and sporadic, the mats are now growing faster and spreading wider. According to Wang et al. (2019) the sargassum mats have increased in aerial size during the past years and the mats have also gained in both weight and thickness. The area of sargassum mats is considered the biggest macroalgal bloom in the world, and it reaches from West Africa all the way to the Gulf of Mexico, Florida and the Caribbean Sea (Thompson et al., 2020, Wang et al., 2019). When sargassum reaches the coastline, known as *sargassum beachings*, an anaerobic decomposition of sargassum takes place. This decomposition leads to a release of several toxic compounds threatening human health, of which the toxic gas hydrogen sulphide ( $H_2S$ ) is one of the most widely known (de Lanlay et al., 2022). Although sargassum can be considered as a health hazard for humans, it is important to state that sargassum mats floating in the ocean should not be considered as something harmful per say. The brown algae mats are a natural phenomenon in our oceans and supports the marine ecosystem, as well as providing habitat for many living species. However, the massive and uncontrollably growing sargassum beachings and influxes have become a problem and since it has been going on for several years, it can be declared as a chronic issue (UNEP, 2021). Since 2011, the French island Guadeloupe has periodically been affected by massive sargassum waves and beachings. Today, the problem with the brown algae is so severe and widespread, that it has been mobilising the public authorities for over ten years (Préfet de la région Guadeloupe, 2022). As of today, the massive sargassum waves and beachings have contributed to a serious health concern in the area, but also developed into ecological and economic problems (Rodríguez-Martínez et al., 2023). Further, the excessive presence of sargassum is today considered a real threat to human health (Resiere et al., 2018). The concern of the brown algae is estimated to have an impact on over thirty countries in the area affected by the waves and beachings of sargassum (Rodríguez-Martínez et al., 2023). In the Caribbean, sargassum exposure is linked to more frequent medical consultations and hospital admissions since year 2018. An individual can need medical care both because of acute exposure to sargassum or chronic exposure. In order to combat the issue, economic and environmental measures need to collaborate with a public health approach on a regional level. For example, measures should include monitoring the level of the toxic gas  $H_2S$  on the areas impacted by sargassum beachings and decomposition of sargassum. According to Resiere et al. (2019) trained physicians and toxicology experts will be needed in order to have a well-functioning monitoring system.



## Location of study

The location of this case study is Guadeloupe, a French overseas region and island group belonging to the European Union. It is located at the centre of the Caribbean islands, in the southern Caribbean Sea, and has a tropical climate. The main island's shape resembles a butterfly, and it includes eight distinctive islands and island groups. Further, the main island is in fact made from two separate islands, Basse-Terre and Grande-Terre, which are connected by a bridge. In 2016, the population was estimated to be 395,700 inhabitants (Préfet de la région Guadeloupe, 2022). Guadeloupe has a productive system with a polarised economy and income economy. The polarised economy is mainly based on tourism, and the overall economy on agriculture. The main crops of the agricultural sector are bananas and sugar cane (Ministère de la Culture, 2022). Due to the case study's public health perspective, United Nation's 17 Global Goals (SDGs) and Agenda 2030 have been considered. Back in 2015 the UN developed different goals for a better world by 2030. This study is linked to the SDGs, especially goal three - *good health and well-being*, goal thirteen - *climate action* and goal fourteen - *life below water* (UN, 2023).

## Previous research

### Public health and Environmental health in Guadeloupe

Guadeloupe experiences unfavourable public health compared to mainland France. Public health in the island combats specific health issues, such as an increase of chronic diseases, higher premature mortality, higher level of infant mortality and vector-borne diseases (ARS, 2018). Two of the main public health concerns of Guadeloupe are diabetes type 2 and cardiovascular disease (Sinnapah et al., 2009). Further, limited structural factors have an impact on public health in Guadeloupe. For example, low medical density, weak development and lack of care for certain diseases, especially diabetes (ARS, 2018). Further, intensive care unit beds have an inadequate capacity, which is an issue that needs to be addressed (Kallel et al., 2021).

As of today, Guadeloupe has a relatively young population. The population is decreasing, however a growth of people aged over 75 years is expected in the upcoming years, and Guadeloupe is anticipated to become the third oldest department of France within the upcoming twenty years. Although premature mortality has decreased during the past decade, it remains high. The high prevalence of chronic diseases is considered to impact pregnancies and births (ARS, 2018). In addition to cardiovascular disease and diabetes, overweight and obesity are significant health concerns, with 23 percent of the population considered obese. In Guadeloupe there is an elevated presence of certain cancers, in particular prostate cancer. The island is further withstanding health concerns and deaths due to excessive alcohol use (ARS, 2018).

Being an island destination in the Caribbean, Guadeloupe has a diverse and rich flora and fauna. However, its ecosystem is sensitive, and the environment is facing several concerns. The three main concerns affecting both environmental health and public health on the island are soil degradation, deforestation and water pollution, of which soil degradation is considered the most severe (Coat et al., 2011, UNEP, 2010). Guadeloupe is further particularly vulnerable to extreme natural disasters, such as earthquakes, cyclones, and floods. Today, invasions of the coast by sargassum are also considered a public health concern. Being a tropical region, Guadeloupe is also combating frequent epidemics of vector-borne diseases, such as dengue, zika and chikungunya. These diseases may lead to chronic health concerns and can be life-threatening, thus requires special attention and management (ARS, 2018).

Previous research also states alarming levels of pesticides in freshwater ecosystems, levels exceeding the French standards and regulations for pesticide concentrations, as well as antibiotic-resistant bacteria present in the surrounding freshwaters (Coat et al., 2011, Guyomard-Rabenirina et al., 2017). One of the main pesticides present on the island is *chlordecone*, a pesticide that was used on the banana plantations during the years 1973 to 1993 and which resulted in a severe health scandal. The pesticide has many health disadvantages and is a developmental and reproductive toxicant (Coat et al., 2011, Multigner et al., 2016). Previous studies show an association between chlordecone exposure and an increased risk of preterm birth. The association has an important relevance for public health still today, since chlordecone is present in the environment, although it has not been used actively during the past three decades (Kadhel et al., 2014, Multigner et al., 2016).

## **Lifestyle in Guadeloupe**

Guadeloupe being a part of France, lifestyle factors contributing to disease and health concerns in French health statistics have been considered. In France, cancer is one of the most prominent causes of disease and death. Developing cancer is linked to both lifestyle and environmental factors. In France, the main risk factors for cancer are obesity and smoking. Further, consumption of alcohol and unhealthy foods are considered particular risk factors (Soerjomataram et al., 2018).

As stated earlier, two of the main public health concerns of Guadeloupe are diabetes type 2 and cardiovascular disease. Both diseases have well-known risk factors, such as having a sedentary lifestyle or poor dietary choices. According to previous research, Guadeloupe's Asian Indian population is in greater extent affected by a sedentary lifestyle in comparison to other inhabitants on the island. Furthermore, previous research show that being a part of an ethnic minority can be linked to a less active lifestyle. Thus, strategies to support an active lifestyle for Guadeloupe's minority Asian Indians is something that should be taken into consideration (Sinnapah et al., 2009). In addition to prevent *non-communicable diseases* (NCDs), having an active lifestyle contributes to healthy aging and quality of life (Bonner, 2017).

Moreover, economic factors have an impact on lifestyle (WHO, 1998). According to previous research, negative economic impacts have been caused by sargassum waves. The economic loss is mostly linked to tourism, since sargassum affects the tourism sector and the tourism economy (Maréchal et al., 2017). Inhabitants of Guadeloupe that struggle economically is a concerning factor. The average declared income is less than half compared to mainland France (ARS, 2018). Furthermore, the work sphere of Guadeloupe is battling several social conflicts and strike days per year, which is believed to be a part of the legacy of slavery. Considering the legacy of slavery, earlier research further shows its link to domestic violence and violence towards children (Ganem, 2023). Lastly, financial tensions are considered a growing problem on the island, which partly is caused by the conflicts and general strikes taking place on the island (ARS, 2018, Ganem, 2023).

Inhabitants' lifestyle can be considered as affected, if they are living in an area exposed to growing amount of sargassum waves, since environmental factors contribute to lifestyle (WHO, 1998). As explained above, sargassum seaweed causes health hazards and disadvantages in form of a toxic gas released during the decomposition process. The gas released contains toxins such as ammonia and H<sub>2</sub>S, which are gases with known health consequences for humans (Stephan et al., 2023). During the search process of previous research of sargassum's impact on people's lifestyle, a lack of research could be found. However, since the released gas from the decomposed sargassum is toxic and it is particularly present along the shoreline and in coastal cities, one can assume that inhabitants living in these exposed areas are to some extent affected (UNEP, 2021).

## **Sargassum in Guadeloupe**

According to Resiere et al. (2023) there is still no effective plan or strategy from the health sector in how to address the public health concern of sargassum in Guadeloupe. The released toxins during the decomposition of sargassum are still categorised as unmanaged. In addition, the local researchers state that to date, it is unsure how the health concerns of sargassum will be approached and prioritised by regional organisations and initiatives. Resiere et al. (2023) points that the most successful solution for Guadeloupe would be to find a way to handle and collecting sargassum within 48 hours of arrival. This statement is done for sargassum present both on land and in the sea.

Furthermore, the researchers bring up the COVID-19 pandemic as an additional reason to why the sargassum invasion is being not prioritised in the region. The pandemic hit the Caribbean islands hard, since most of the islands' economies rely on tourism and the hotel sector (Resiere et al., 2023). Presenting the economic situation in the study's location while focusing on health and lifestyle is supported by the WHO, which declares that different economic concepts and systems can either support or decline health in general (WHO, 2018). Although waves of sargassum have a negative impact on the tourism sector and could therefore be understood as being prioritised since restarting the tourism industry is placed high on the agenda after the pandemic, the reality remains different. Resiere et al. (2023) explains that the economic consequences of the COVID-19

pandemic will lead to even less priority of approaching the matter of sargassum. In addition, local health care systems have been overloaded and working over their capacity due to the pandemic. It is stated that this will only further not prioritise health concerns of sargassum, which are yet left to a large amount unknown. However, the pressure to deal with the concern of sargassum is growing, although local governments have to a certain amount succeeded to postpone it. Among others, local fishermen are identified as a sector that pushes for solutions to be found and for the health concern to be prioritised. According to Resiere et al. (2023), fishermen have had their electronic appliances and engines, both domestic and in work, affected by the gases formed during the decomposition of sargassum. This has led to collection of sargassum and local initiatives, however they remain insufficient and sporadic.

As of today, local governments in the Caribbean have not come up with a collaborative plan on how to approach the overwhelming problem with sargassum exposure and influxes. Thus, there is no identified national or international agreement on how to face this public health concern. Despite of the French Government's earlier initiatives to combat the waves of sargassum in the French West Indies, the problem keeps growing. Five years ago, in 2018, the first plan for Guadeloupe and how to combat the problem of sargassum was released. The plan had a total worth of 10 million euros, but inhabitants in the affected areas are still touched by the brown algae (Bernard et al., 2022). The goal with the plan was to cover for sufficient equipment to enable removal of sargassum within a period of 48 hours from arrival to the shoreline. Further, the grant has been used for efficient monitoring systems to track toxic gases on the affected shores, as well as to train physicians and experts within toxicology (Resiere et al., 2018). In 2022, a second plan was released to combat sargassum and it has further been stated in the European Parliament, in November 2022. Despite these attempts from the French Government, methods and strategies of combating sargassum influxes remain insufficient, and a global plan to address the public health concern remains fundamental (Bernard et al., 2022, Resiere et al., 2018).

Previous research in the area has found a peak of sargassum waves and beachings during a period of six months, from March to August. The researchers have stated that today's conventional forecast models of incoming sargassum waves would have to be updated to a predictive system of clustering analysis. By using an updated version, less resources would be needed, and the version would further concentrate the risk management in the affected region (Bernard et al., 2022). In addition, an increase of hospital admissions and health care has been identified in the Caribbean due to sargassum exposure (Resiere et al., 2018). According to the Regional Health Authority (ARS), local physicians have noted increased number of medical consultations provided due to chronic exposure to H<sub>2</sub>S (Anses, 2017).

# Theoretical framework

## Health

In the Shanghai Declaration 2016, health is considered crucial in order to achieve sustainable development. In addition, the declaration states that health is a general right for everyday living and having a shared social goal. Health is also globally recognised as a political priority (WHO, 2017). As claimed by the World Health Organization (WHO) one can define health as “*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*” (Green et al., 2019, p. 10). Even though the definition has received criticism, it can be argued to be the best-known definition existing today (Green et al., 2019). An alternative way to define health is presented by Nordenfelt (1991), which considers health as an individual’s abilities. To be in good health means one has the abilities and resources to act, whereas disease or poor health states the opposite, a limited ability to act. In this study, health is recognised according to Nordenfelt’s perspective and theory on health. Therefore, the study considers both a holistic and a medical approach, since Nordenfelt’s theory incorporates them both (Nordenfelt, 1991, Green et al., 2019).

## Health information and health literacy

To define health information according to Nordenfelt (1991), it is all information which promotes, maintains or improves an individual’s health status. For this study health information is seen through a holistic perspective, which includes all data and information about health, both scientific information and non-scientific. Health information through this perspective includes health in relation to physical, social and mental health (Nordenfelt, 1991). In order to receive and comprehend health information, *health literacy* becomes vital. The concept of health literacy can be defined as an individual’s reading and literacy capabilities to apply and understand health information. Health literacy includes cognitive and social skills and is a non-stagnant process. Therefore, limited health literacy can have a negative impact on an individual’s health, due to lack of information or comprehension within health. Various social factors have an impact on health literacy, among others the environment, culture, living situation and educational level. Furthermore, both health information and health literacy can be used as a tool to change an individual’s lifestyle (WHO, 1998).

## Lifestyle

Comparable to health, lifestyle is a complex term. To define lifestyle, one can start with identifying it as a major contributor for improving health. However, a common definition of the term has yet to be agreed on. For this study Green et al. (2019) definition of lifestyle is used. They define lifestyle as the following “*patterns of behaviour that have an enduring consistency and are based in some combination of cultural heritage, social relationships, geographic and socio-economic circumstances, and personality*” (Green et al., 2019, p. 99). Thus, behavioural factors are

commonly included in the term lifestyle, as well as the way an individual chooses to live her or his daily life (Green et al., 2019). While defining lifestyle it is important to remember that a general optimal lifestyle for everyone does not exist, what is considered a good and healthy lifestyle is highly individual (WHO, 1998). On a global level, NCDs stand for over seventy percent of all deaths. Suffering from a NCD has four different risk factors, which are all linked to lifestyle. The known risk factors are physical inactivity, excess alcohol intake, having an unhealthy diet and the use of tobacco products (Green et al., 2019). Today there is a continuous debate according to who or what is considered responsible for a state, community or group to have what we observe as a *healthy lifestyle* (Green et al., 2019). Thus, a healthy lifestyle as a phenomenon has become linked with both ideological and political perspectives on a global level. In order to divide the responsibility between different sectors, four key roles have been introduced, namely food, alcohol intake, health at work and physical activity (Green et al., 2019). For this study, the focus is on the key area physical activity for a healthy lifestyle. However, a connection with health at work can also be recognised, which will be discussed later.

## **Environmental health**

According to WHO, the majority of identified major diseases on a global scale can be linked to risk factors in the surrounding environment (Price & Barua, 2021). In addition, Nordenfelt (2001) states that the environment can be perceived as an opportunity for an individual to do a certain action or not to do it. However, the environment cannot only be considered as an area for different actions to take place, since it also has an impact on the individual. Nordenfelt (2001) explains that the impact can be both direct and physical. For example, an individual can suffer health consequences due to water pollution and the impact can lead to weaker overall health. Therefore, developing and working for a healthier environment decreases threats for poor health. This process is called *health-enhancing*. Health enhancement can further be divided into *health promotion* and *environmental care*. A type of health enhancement and health promotion is *environmental health promotion*. Environmental health promotion can support and have an impact on an individual's behaviour, such as physical exercise. In addition, environmental health promotion can directly have an impact on an individual's health. For example, minimising pollution or decontaminated water. Nordenfelt's (2001) definitions and views work well with this study's aim and focus, which is why it has been chosen.

## **Rational**

There seems to be a lack of knowledge when it comes to health effects due to sargassum exposure and its impact on lifestyle factors. Previous research can be found about sargassum's impact on health, however research focusing on sargassum's impact on lifestyle is poor. The long-term health consequences due to sargassum exposure are also to some extent unknown, since the issue is relatively new. Further, climate change has been shown to be a partial reason for rapidly growing sargassum waves and beachings.

Thus, the study explores a current health topic, and contributes to a wider understanding about the matter. An interview study was chosen as a methodological approach to contribute to a more generous comprehension about the matter.

## Aim

The purpose of this study was to explore how Guadeloupe island is handling sargassum waves and beachings, and how inhabitants' health and lifestyle are affected.

The research questions are the following:

- 1. Which strategies of approaching the brown algae sargassum can be identified when organisations operate in Guadeloupe?*
- 2. How does the brown algae sargassum affect the inhabitants' health and lifestyle in Guadeloupe?*

## Method

This chapter will present the methodology that has been used in the study, including *Design, Sample, Presentation of participants, Delimitations, Collection of data, Methodological approach, Analysis of data, Reliability and validity* and *Ethics*.

### Design

The study has a case study design with qualitative content analysis and an inductive approach to identify similarities and differences in the text content (Lindgren et al., 2020). The goal of a case study is to get greater understanding or learning the case in depth. Therefore, case study as the study's design was chosen (Bryman, 2019).

### Sample

The informants in the study have been chosen through *targeted selection*. Firstly, chosen informants were contacted through email or phone. Later it became clear that it was best to visit the informants and their workplaces directly, since contact by email or phone did not produce desired effect. Informants working in a specific field for the study later also gave tips and contact details of other possible participants for the study, thus an advantage of the study taking place on an island where people know each other well and distances are relatively small was noticed. Therefore, the study's targeted selection developed into a form of *snowball sample*. The chosen informants are organisations that work in several different ways with combating sargassum, for inhabitants' health and lifestyle and the overall environment in Guadeloupe. Only local initiatives and informants that operate in Guadeloupe have been studied. Due to the study's focus, informants have been chosen within the sectors; health, lifestyle and the environment.

## Presentation of participants

Informant 1 is an educator for a local non-profit educational association working with spreading information about the marine world. Excessive waves of sargassum have been affecting their work and activities the past decade. Informant 2 is the co-founder for a local non-governmental organisation founded in 2019. The organisation arranges several eco-friendly activities, such as planting trees, as well as informing inhabitants about how to protect the nature and spreading environmental awareness. Further, the organisation works with combating sargassum by organising beach-clean ups. Informant 3 is a specialised physician and co-founder of a private medical office, which is in a city along the coastline highly affected by stranded sargassum. The medical office offers services within specialised healthcare, physiotherapy, midwifery and osteopathy. Informant 4 is a general physician working for a modern public hospital. Informant 5 is a pedagogue working for a private educational organisation, that arranges different activities and tutoring for children. The organisation is geographically located in a region exposed to sargassum and thus tackles various obstacles due to the seaweed. Informant 6 is a nurse working for a private medical clinic that offers care for instance within paediatrics, emergency care, gynaecology and diabetology. The clinic was especially chosen as a participant for the study since it operates in a city highly exposed to sargassum. Informant 7 is a sport professional and co-founder of a local maritime association. The association organises different nautical sport lessons for people in all ages. The association's activities and daily operations are affected by sargassum during the period of excessive seaweed waves arriving to Guadeloupe. Informant 8 is the administrative and financial director of a public marina office. Informant 9 is working as the referent for tourist activities for a local tourist office. Lastly, Informant 9 is the financial director of a public marina office. Below is a table of all participated informants.

**Table 1. The participated organisations.**

Organisation	<i>NGO</i>	<i>Orientation</i>	<i>Method used</i>	<i>Informant</i>
1	Yes	Protecting the ocean	Interviewed	Informant 1
2	Yes	Protecting nature	Interviewed	Informant 2
3	No	Health	Interviewed	Informant 3
4	No	Health	Interviewed	Informant 4
5	Yes	Education	Interviewed	Informant 5



6	No	Health	Interviewed	Informant 6
7	No	Physical activity and lifestyle	Interviewed	Informant 7
8	No	Marina	Interviewed	Informant 8
9	No	Tourism	Interviewed	Informant 9
10	No	Marina	Interviewed	Informant 10

### **Delimitations**

Organisations that work and operate in Guadeloupe with knowledge of sargassum, and with a clear connection to either health or lifestyle factors in their work.

### **Collection of data**

The data has been obtained through ten *semi-structured interviews* with different organisations that operate in Guadeloupe. The interviews were held at a place chosen by the informant, in order to make it easy and convenient to participate in the study. The interviews have been conducted during a period of eight weeks and have been the basis for the analysis and conclusions followed later. Semi-structured interviewing was chosen as a data collecting research method, in order to get the chance to have an open mind about the research topic, and after unfolding theories and concepts out of the data. Further, the chosen data collection form pairs well with the study's inductive approach (Bryman, 2019). The interview guide has been tested and reviewed during a separate pilot study, in order to try out its suitability for data collection. For example, the part of voluntary additional information at the end of the interview guide was added, and the questions regarding UN's global goals were deleted. The pilot study was conducted in Guadeloupe with a local organisation working within the field of sport in a city greatly exposed to sargassum, in order to get the most accurate feedback and trial.

### **Methodological approach**

As presented above, interviews were chosen as a data collecting method for the case study. The choice to choose interviews as a methodological approach felt natural, considering the study's aim, its timeline and budget, as well as geographical and cultural reasons. Additionally, interviews are

the most common method in qualitative research (Lindgren et al., 2020). The interest and focus have been on the participants' knowledge, beliefs and experiences. Furthermore, the aim with the chosen methodological approach is to get a wide and detailed understanding of the studied matter, which worked well with the study's aim (Bryman, 2019). Hence, interview as a method for this qualitative case study was chosen. In addition, the method has made it attainable to possess a certain amount of flexibility and personalisation during the data collection (Lindgren et al., 2020). For example, different spontaneous follow up questions have been asked during the interviews. Furthermore, the informants have been given space and the possibility to talk about matters that they have the most knowledge and passion about, however always staying inside the structure of the interview guide. Semi-structured interview as the study's methodological approach has worked well, since it has given a certain structure, but still contributed to form every interview situation and meeting unique (Bryman, 2019).

## Analysis of data

As stated above, an inductive approach has been used, where the collected data has been the foundation to draw conclusions and for analysing it. The study's inductive approach can further be seen as a facilitator for the study, since the goal was to gain a deeper understanding about the research topic, rather than to prove an existing hypothesis (Bryman, 2019). The interviews have been transcribed and the produced texts read in detail and depth. After, the data has been analysed through *thematic analysis*. In thematic analysis the material is categorised into a set number of themes, which are chosen according to the research questions. In addition, the data has been broken down through the process of coding, and each part has gotten a code. After, the codes have been analysed and the frequency of each code, as well as connections between different codes (Bryman, 2019). Barriers along the analytical process have been to clarify the distinction between the codes, subcategories and categories. This was however investigated, and later more distinct categories were chosen. During the analytical process the study's supervisors have offered support and validation.

**Table 2. Data analysis.**

Meaning units	Condensed meaning units	Code	Subcategory	Category
"People have to adapt their activities and lifestyle depending on the situation of sargassum, like what places they can go to or where they can spend time. It is frustrating, time consuming and also lead to traffic jams"	Need to adapt lifestyle and activities because of sargassum, which is time consuming and creates traffic.	Lifestyle affected	Quality of life	Sargassum and health

<p>“I don’t really know. The problem is quite new, so we might not see yet how bad it is really affecting our health. The future feels unsure.”</p>	<p>The problem with sargassum is new, thus the impact on health is unsure, which affects the future.</p>	<p>Lack of knowledge</p>	<p>Health literacy</p>	<p>Awareness of sargassum</p>
<p>“People with allergies and with rhinitis, are extra sensitive to sargassum exposure. It irritates the skin, the eyes, and the nose. So, the breathing canal and emunctories.”</p>	<p>People with allergies are sensitive to sargassum exposure. Sargassum irritates the breathing canal.</p>	<p>Health affected</p>	<p>Priority of health</p>	<p>Sargassum and health</p>

## Reliability and validity

The purpose of a study’s reliability is to reduce the risk of errors and misrepresentations, and it includes if and to what level a study would achieve the same results in case it would be replicated (Bryman, 2019). Taken into consideration the study’s methodological approach and its characteristics, for example spontaneous follow up questions, one can argue that the study’s reliability is relatively low (Lindgren et al., 2020). Additionally, the sample of this study was chosen partly according to their geographical location in Guadeloupe, due to the study’s limited budget and timeframe. Organisations working and operating in areas or cities greatly exposed to sargassum during longer periods were prioritised. Hence, redoing a study by interviewing organisations from different geographical locations could give a very different outcome. Moreover, all documents provided to the informants and most interviews have been conducted in French. While translating the data to English in the best possible way and with a lot of consideration, it is inevitable that different nuances of certain words or phrases may occur. A study’s validity refers to if the study in fact examines what it is aimed to do (Bryman, 2019, Lindgren et al., 2020). During all interviews the interview guide has been used and followed, therefore the discussions have been inside the structural frame set beforehand. Further, as already presented, a pilot study was held in order to determine the questions in the interview guide and the structural frame of the data collection. The interview guide’s questions have further been discussed and validated by the supervisors of the study, and the aim has been that the questions work well together with the chosen theoretical framework (Bryman, 2019).

## Ethics

The study has not applied for ethical approval from the Swedish Ethical Review Authority and has therefore only been carried out as a student work for a thesis. Nevertheless, the study has taken ethical considerations and guidelines into account (Swedish Research Council, 2017). The study follows the Declaration of Helsinki (2013) and the requirements of proper

research presented by the Swedish Research Council (2017) (WMA, 2023). All informants have been informed both in writing and orally about their ethical rights, the study's ethical guidelines and that their participation is completely voluntary. Furthermore, participants have been given the choice to end their participation in the study by any time and without having to state a reason. A written consent to participate in the study has been given before the held interviews.

## Results and analysis

This chapter will present and simultaneously analyse the results from the ten semi-structured interviews. Chosen citations from the semi-structured interviews will be described. As a reminder the research questions are: *“Which strategies of approaching with the brown algae sargassum can be identified when organisations operate in Guadeloupe?”* and *“How does the brown algae sargassum affect the inhabitants’ health and lifestyle in Guadeloupe?”*.

**Table 3. Overview of categories and subcategories.**

Categories	Subcategories
Approaching sargassum	Strategies of sargassum management Sargassum and Environmental health promotion
Awareness of sargassum	Health literacy Professional expertise of sargassum
Sargassum and health	Quality of life Priority of health

### Approaching sargassum

The purpose of the first category is to describe, give examples and explain the different identified approaches and strategies the organisations use while handling sargassum. The different approaches could be divided into two subcategories presented below.

#### Strategies of sargassum management

Informant 5 described the local initiatives to combat sargassum as following:

*“The local townhall organises sargassum beach clean ups, but this remains clearly insufficient. So, the problem is very present.”*

The participated informants stated that sargassum has been a problem for many years, mainly the past ten years. Combating the problem remains poor and no clear management strategy was presented. Informant 1 described it by:

*“It has always been a problem, but it is true that since a few years back the problem is way more massive and much more exposed. “*

When it comes to strategies of approaching sargassum on the island, one strategy is to collect the sargassum before it has reached the shoreline. Informant 8 described it as following:

*“There are not many different strategies in Guadeloupe at the moment. But there is one machine on the island, that collects sargassum directly from the sea. It is one enterprise that owns it, and they operate on demand on the whole island.”*

The presented citations below show an insufficient handling of sargassum and that the issue is still very present. Further, the problem of sargassum exposure has grown the past years and become more severe. As a strategy of handling sargassum one machine is operating on the island, which picks up the seaweed directly from the sea. This method can be seen as efficient, since handling sargassum directly from the sea is advantageous compared to decomposed sargassum on land that produces toxic gases. Nevertheless, one machine seems insufficient, since the issue of excess sargassum remains present. Moreover, the informants working in the marina and tourism sector mentioned Guadeloupe’s neighbour island Martinique, and their new strategies for sargassum collection. Not only does Martinique have more physical machines available on demand to collect sargassum efficiently, but the island also has innovative structures in order to let the sargassum pass the shoreline and thus limit how much sargassum reaches the land. These new strategies could be seen as an implication for how to handle sargassum more efficiently also in Guadeloupe.

### **Sargassum and Environmental health promotion**

During the data sampling, it was clear that informants were hopeful about the future. Below is a citation by Informant 5.

*“I wish that we could use the sargassum to do something sustainable here in Guadeloupe. Because we have so much of it, I believe we could use it and change something negative to the positive.”*

A raised environmental awareness among the inhabitants was also described. Informant 7 described it as the following:

*“People start thinking about their actions’ impact on the environment and surroundings. They get more understanding of the impact of their activities.”*

From an environmental health promotional perspective, hope and motivation for handling sargassum in the future can be understood from the citations above. Sustainable handling methods are wished for, and inhabitants’ daily life is affected to a more environmentally friendly way of living, since people become more aware of their environment and their actions.

## **Awareness of sargassum**

The second category describes the divided level of awareness and knowledge about sargassum among the informants. The relatively weak understanding and knowledge of sargassum is presented under the subcategory health literacy, and a found wide professional expertise of sargassum is explained after.

### **Health literacy**

The health literacy is possible to identify as inadequate among the informants. Informant 1 described the future as unsure.

*“I don’t really know. Problem is quite new, so we might not see yet how bad it is affecting the health. The future is unsure.”*

Further, anxiety and fear were outlined. Informant 6 described the anxiety as following:

*“A lot of people are scared. Because of the scandal of chlordecone before, people are very anxious and scared concerning their health.”*

The health literacy around sargassum could be identified as incomparable during the data sampling process. Whereas health professionals had great knowledge and competence of sargassum’s health outcome, other participants did not manifest the same competence. Even a lack of competence around health questions linked to sargassum could be recognised. The citation of Informant 7 describes the matter below.

*“To be honest, I don’t really know how sargassum affects our health. But what I can think of are respiratory problems, because of the gas formed during the decomposition. The gas can’t be healthy.”*

From a health literacy perspective, a lack of knowledge and information can be seen. This is partly due to excessive sargassum exposure being a relatively new phenomenon, thus long-term effects are yet unknown. Nevertheless, this leads to a feeling of fear and anxiety about the future, and their health.

### **Professional expertise of sargassum**

The participants that work within the health sector seemed to have a great knowledge and expertise of diverse health issues caused by sargassum. Several symptoms and patients in greater risk of sargassum exposure could be stated, and below is one example by Informant 3.

*Have you identified certain risk groups, people that have a greater risk to experience health concerns caused by sargassum exposure?*

*“People with rhinitis or asthma. Also, patients with atopic or sensitive skin or patients suffering from allergies.”*

Furthermore, Informant 4 explained that the gas released by sargassum during the decomposition process irritates the breathing canal and the emunctories.

## **Sargassum and health**

The last category, sargassum and health, focuses on two different perspectives on health. The first subcategory is quality of life, which contemplates how sargassum has an impact on inhabitants' daily life and lifestyle. The second is priority of health, which explains to what extent informants experienced that the public health issue of sargassum is prioritised in the society today.

### **Quality of life**

The participated informants agreed that the smell of decomposing sargassum has an impact on their lifestyle and quality of life. The smell is not only unpleasant and toxic, but also limits the areas where people can spend their time and therefore creates traffic jams. Fishermen as a profession were specifically mentioned as affected by sargassum on their quality of life. Further, the variety of leisure activities and exercise of physical activity are limited. Informant 2 and 9 described it as following

*“Sargassum causes nauseous odours and limited access to beaches. The choice of leisure activities is decreased, and many people choose the same areas to hang out on.”*

*“People have to adapt their activities and lifestyle depending on the situation of sargassum, like what places they go to or where they can spend time. Many times, it is impossible to swim or go jogging around the beach.”*

Further, Informant 9 brought up sargassum's impact on the tourism sector.

*“It affects the touristic season, so it affects people's economy. Sargassum shortens the tourism season.”*

In addition, the inhabitants' lifestyle and quality of life is affected by which areas are habitable. Informant 2 described it by explaining the following:

*“Many people leave Guadeloupe or move somewhere else to another area on the island less exposed to sargassum.”*

Informant 10 described a specific profession highly impacted by sargassum waves. Below is a citation:

*“Mainly the fishermen are affected by sargassum, since the fishing is affected. Because where there is sargassum, you can't fish.”*

Sargassum waves and exposure affects the lifestyle on the island due to the toxic gases which release a nauseous odour. This odour and health hazard contributes to a delimitation of areas and environments to spend time on, and a narrower variety of both leisure and physical activities. Further, sargassum leads to a shorter tourism season, which causes economic shortage. For lifestyle factors linked to the environment and quality of life, sargassum seaweed is responsible for people moving to other less exposed areas on the island or leaving the island. Fishermen as a profession are identified as specifically affected by sargassum exposure.

### **Priority of health**

The priority of different health factors and dealing with health consequences of sargassum is unclear. The informants were unsure how work around sargassum will be prioritised and how health will therefore be affected. The future seems unsure, and Informant 8 described the following:

*“To clean up sargassum in an effective, healthy and eco-friendly way costs money. People seem interested, but I am not sure if they will be keen to pay extra for the service.”*

In addition, Informant 10 described their organisation’s way to prioritise sargassum collection by the following:

*“We collect sargassum to protect our customers’ boats and for the marina to be working. We haven’t really discussed health.”*

As of today, it remains unsure how handling sargassum will be prioritised, especially concerning the health disadvantages and factors concerning public health. The work around sargassum is according to the data based on other factors and priorities than health factors.

## **Discussion**

This chapter aims to answer the research questions in the study. The purpose of the study was to examine how Guadeloupe is handling the brown algae sargassum, and how inhabitants’ health and lifestyle are affected. To answer the study’s first research question, no effective or sufficient strategy to handle sargassum could be identified, which aligns with UNEP’s (2021) statement that management of sargassum in the Caribbean is inadequate. As of today, sargassum is mainly handled and collected once it has already reached the coastline and shore, which previous studies state is not the most effective method (Bernard et al., 2022, Resiere et al., 2018). The amounts of sargassum that need to be collected are simply too enormous and a rapid enough collection is not present. There is one identified machine that operates in the island on demand, and which collects sargassums straight from the sea. However, one machine for the whole island’s needs seems to be insufficient, since the problem of excessive sargassum on the beaches



remains. Another strategy named by the informants was organised beach clean-ups, and even if this initiative has a positive impact, the intervals of organised clean-ups are too infrequent and non-efficient. Furthermore, people cleaning and collecting sargassum on the beach are often operating without necessary protective equipment and safety measures. Thus, these beach clean-ups from a health perspective can be seen as troublesome, taking into consideration the toxic gases released during the decomposition of sargassum (Bernard et al., 2022, Resiere et al., 2018, UNEP, 2021). One could suggest that Guadeloupe could benefit from using a predictive model and system of clustering analysis of sargassum, which aligns with Bernard et al. (2022) study's findings.

In addition, economic and social consequences can be intended, since a beach or shoreline covered of unappealing odour hold tourism and other social activities at a distance (UNEP, 2021). Furthermore, since economic factors affect lifestyle, Guadeloupeans could experience lifestyle consequences due to economic losses (WHO, 1998). Also, the diversity of physical activities held on the beach or in the water becomes limited when the strategy to handle sargassum is non-efficient. These statements lead us onto answering the study's second research question. This study indicates that there is a knowledge gap among inhabitants in Guadeloupe when it comes to awareness about sargassum, especially how it affects the health. Whereas professionals in the health care sector seemed to have a lot of information about sargassum's impact on health, other individuals mostly expressed a feeling of anxiety or fear due to lack of information. Therefore, a general lack of both health information and health literacy can be indicated. Furthermore, sargassum waves and beachings contribute to delimitation of possible activities that can be done and areas where people can spend their daily lives, thus having an impact on inhabitants' lifestyle. Due to sargassum beachings, traffic jams are inevitable on the island since some areas around the coast become non-favourable or even impossible to spend time on. Inhabitants in greater risk of experiencing discomfort or health concerns because of sargassum exposure are individuals suffering from allergies or other sensitivities of the breathing canal, which aligns with Resiere et al. (2019) earlier findings. In addition, sargassum leads to economic disadvantages. Not only is the tourism sector affected by less income due to less tourists, but also local fishermen are suffering an economic drawback, since areas for fishing are periodically limited and sargassum leads to more rapid engine decomposition (UNEP, 2021). This aligns well with Resiere et al. (2023) previous study, which also identified local fishermen from suffering an economic drawback due to sargassum. As stated earlier, environmental and economic factors have a key role for an individual's lifestyle, thus this study intends that sargassum does have an impact on inhabitants' lifestyle.

Easy access to practice a variety of physical activities and sports can be stated as a priority for the public health in Guadeloupe. Although the island is known for its many successful athletes, they do not give an accurate image of the whole island and its inhabitants. According to previous research, only sixty percent of the adult population reaches the daily recommended level of practicing physical exercise and the island continues having a high prevalence of obesity (Atallah et al., 2016, Foucan et al.,

2017). Thus, sargassum's impact on delimitating areas where physical activities can be practiced should be highlighted. Not only does sargassum reduce the areas where sports and other activities can be held outside, it also reduces which sports can be practiced overall. For example, the variety of nautical sports and activities organised along the beaches are reduced. Additionally, Guadeloupe has a high prevalence of NCDs, particularly diabetes type 2, among the population. This further emphasises the importance of easy access and variety of physical activities on the island (Foucan et al., 2017). Moreover, different attempts and interventions to improve public health may not succeed in terms of being effective for several reasons. Focus is frequently on an individual's behaviour, instead of the environmental and social determinants of health (Green et al., 2019). Therefore, the concept of environmental health and environmental health promotion can be recommended.

## Conclusion

The study's aim was to explore how sargassum waves and beachings are handled in Guadeloupe and how inhabitants' health and lifestyle are affected. The conclusion of the study is that more information is needed about the health effects of sargassum and that the health literacy among inhabitants is lacking, which can be seen as a barrier for local agencies to handle sargassum. More efficient measures and strategies to handle the brown algae sargassum are needed, since inhabitants' lifestyle and especially the variety of physical activities are affected. Further, many areas become inhabitable or inaccessible due to sargassum along the shoreline. Inhabitants' health is mainly affected by the toxic gas released during the decomposition of sargassum on land, and people with allergies or other breathing canal sensitivities are experiencing a wider range of symptoms. Sargassum further has an economic impact on health and lifestyle. From a public health perspective, exposure of sargassum can be seen as an obstacle for the destination to fulfil UN's global goals and work for Agenda 2030. This study indicates that sargassum waves and beachings can be considered a public health concern that requires international policies, further research, as well as funding, in order to combat the public health issue and to develop a sustainable strategy to handle sargassum in the future.

## Implications

Based on the study's results, the chosen theories and previous research, this study's findings suggest that handling of sargassum should be highly prioritised in the destination, and more research is needed about health concerns due to sargassum exposure. In order to support health literacy, accessible information about sargassum and its impact on health should be provided to all. Further, a collective and collaborative strategy to handle sargassum in the Caribbean would be beneficial, as well as collecting sargassum directly from the sea, since health consequences and concerns can thus be minimised.

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# Appendix 1. Interview guide

## **Background**

- What is your position in the organisation you work in?
- When did the organisation start their operation?
- What are the challenges and the opportunities with operating in Guadeloupe?

## **Health**

- How does sargassum affect inhabitants' health?
- What different effects on an individual's health caused by sargassum exposure are there?
  - o The different aspects; *social, psychological and physical*.
- Have you identified certain risk groups? (People having a greater risk to experience health concerns caused by sargassum exposure).

## **Lifestyle**

- How does sargassum affect the inhabitants' lifestyle?
- What methods are there to support inhabitants' health and lifestyle negatively affected by sargassum?
- Have you identified certain risk groups? (People experiencing their lifestyle more affected caused by sargassum exposure compared to others).

## **Sargassum**

- When did you start to combat and handle the brown algae sargassum? When did it develop into a problem for the island?
- Which all sectors are affected?
- What is the organisation's vision and mission regarding the work around sargassum?

## **Environmental health and Agenda 2030**

- What is the focus in your environmental work?
- How are the inhabitants informed about your work?
- How do people respond and react when they get more information about sargassum and its negative impact?
  - o Impact on health and the environment

## **Additional questions**

- Anything you would like to add?



## Appendix 2. Consent for personal data processing in an essay examination

### **Information to you who will take part in a study, performed by a student as part of their education**

You are invited to take part in the study “*Sargassum seaweed in Guadeloupe: a public health concern*”. The study aims to examine how Guadeloupe is handling with the brown algae sargassum, and how the inhabitants’ health and lifestyle are affected. Furthermore, the study intends to investigate what consequences the sargassum waves can lead to, linked to UN’s Global Goals and Agenda 2023.

The study is part of my education, in Health and Lifestyle at the School of Health at Halmstad University. The responsible teachers are Kristina Ziegert [kristina.ziegert@hh.se](mailto:kristina.ziegert@hh.se) and Lars Kristén [lars.kristen@hh.se](mailto:lars.kristen@hh.se).

Your personal data will be processed within the study, only according to your consent, and the demands of the GDPR. Your participation in the study is entirely voluntary, and you can revoke your consent at any time, without stating a reason. Withdrawing your consent will not impact the processing made before your revoking. You may also at any time, ask for a copy of your personal data.

The material will in part be processed within the cloud service Microsoft Office 365. The University has a data processor agreement with Microsoft. Unauthorised persons will not have access to your personal data.

The personal data I will process is name of organisation or business and email address.

Your personal data will be deleted when my examination paper is approved. The personal data controller for the study is Halmstad University, which can be reached through [registrator@hh.se](mailto:registrator@hh.se) or +46 (0)35 16 71 00. You find more information on how the University processes personal data, and your rights according to the GDPR at <https://hh.se/gdpr>. If you have any questions, you can also contact the University data protection officer, Anna Frederiksen, at [dataskydd@hh.se](mailto:dataskydd@hh.se).

The completed essay will be published on DIVA and be available digitally on the DIVA portal <http://www.diva-portal.se/>

Best regards,

Hanna Grönroos, [hanna.gronroos@xx.se](mailto:hanna.gronroos@xx.se)  
Master’s in Health and Lifestyle, School of Health and Welfare  
Halmstad University

**Consent to participation in Sargassum seaweed in Guadeloupe:  
a public health concern**

I have received information about the study “*Sargassum seaweed in Guadeloupe: a public health concern*” and consent to participate.

I have received information that the personal data that is collected will be processed confidentially, in a manner that my identity will not be disclosed to unauthorised persons.

I am aware that my participation is voluntary, and that I at any time and without explanation can discontinue my participation.

Signature

.....

Clarification of signature

.....

Date and place

## Appendix 3. Manuscript

### **Sargassum seaweed in Guadeloupe: a public health concern**

*An interview study in Guadeloupe, French West Indies*

Author: Hanna Grönroos

Date: 2023-10-18

## Abstract

**Purpose** *Waves of the brown algae sargassum have been floating around the island Guadeloupe for years, but most noticeably during the last decade, since 2011. The overwhelming amount of sargassum has been linked to climate change and the release of fertilisers into the ocean. Sargassum has been shown to cause negative health effects, including dizziness, nausea, breathing difficulties and eczema.*

**Aim** *The aim of this study was to examine how Guadeloupe is handling the seaweed sargassum, and how inhabitants' health and lifestyle are affected.*

**Method** *In this inductive qualitative study, semi-structured interviews were held with ten local informants and organisations that work with sargassum as well as health or lifestyle factors for the inhabitants in Guadeloupe. In the study qualitative content analysis was used as a method.*

**Results** *The results show an increased amount of concern about the health effects linked to the brown algae sargassum and a knowledge gap when it comes to health information about the brown algae. No efficient or collaborative strategy to handle sargassum on land could be identified, and the island is dealing with the health consequences that the decomposition of sargassum produce. Inhabitants' lifestyle and health are affected by excessive sargassum exposure, further economic disadvantages could be recognised.*

**Conclusion** *The study's conclusion is that more information is needed about the health effects of sargassum, health literacy among the inhabitants requires development and prioritisation, and more effective measures to get rid of brown algae are necessary. In addition, waves of sargassum can be seen as an obstacle for the destination to work for the United Nation's global goals and Agenda 2030.*

## Background

Since 2011, the French overseas department Guadeloupe, located in the southern Caribbean, has been periodically affected by massive currents of the brown algae *sargassum*. Sargassum is a type of large algae that floats in island-like masses and does not attach to the seabed. The problem of brown algae is so widespread that it has mobilised the authorities for over ten years in Guadeloupe (Préfet de la région Guadeloupe, 2022). According to previous research, there is currently no effective plan from the health sector in Guadeloupe for how the public health concern regarding sargassum should be taken care of. When excessive amounts of sargassum is left untreated along the coast and on the beaches, the brown algae start to break down and a toxic gas is formed (Bernard et al., 2022, Resiere et al., 2018). This gas releases unspecified toxins, including hydrogen sulphide (H<sub>2</sub>S) and ammonia. Local researchers in the area state that it is still uncertain how the public health concern with sargassum seaweed will be handled and prioritised by regional organisations and initiatives. Resiere et al. (2023) highlight that the most successful solution for Guadeloupe to combat the issue of sargassum is to find a way to handle and collect sargassum within a period of 48 hours. Effective collection and handling of the brown algae, both on land and in the sea, would further minimise the toxic gas released during the decomposition process of the algae (Resiere et al., 2023).

## Theoretical framework

### Defining Health and Lifestyle

As claimed by the World Health Organization (WHO), *health* can be defined as "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" (Green et al., 2019, p. 10). Another way to define health is presented by Nordenfelt (1991), which considers health as an individual's abilities. To be in good health means one has the abilities and resources to act, whereas disease or poor health states the opposite, a limited ability to act (Nordenfelt, 1991, Green et al., 2019).

In order to define *lifestyle*, one can start by identifying it as an important contributing factor to improving health. Lifestyle can be defined as "*patterns of behaviour that have an enduring consistency and are based on some combination of cultural heritage, social relationships, geographic and socioeconomic circumstances, and personality*" (Green et al., 2019, p. 99). Thus, behavioural factors are usually included in the term lifestyle, as well as how an individual chooses to live their daily life (Green et al., 2019). Furthermore, socioeconomic and environmental factors contribute to an individual's lifestyle (WHO, 1998).

### Defining Health information and Health literacy

According to Nordenfelt (1991) *health information* is all information that promotes, maintains or improves an individual's state of health. For this

study, health information is viewed through a holistic perspective, encompassing all data and information about health, both scientific and non-scientific information. Health information through this perspective includes health in relation to physical, social and mental health (Nordenfelt, 1991). The concept of *health literacy* can be defined as an individual's reading and literacy ability to apply and understand health information. Health literacy includes cognitive and social skills, and is a nonstationary process (WHO, 1998).

### Defining Environmental health

As stated by Nordenfelt (2001), the *environment* can be perceived as an opportunity for an individual to do a certain action or not. However, the environment cannot be considered only as an area for various actions to take place, as it also affects the individual. Nordenfelt (2001) explains that the impact can be direct and physical. Thus, developing and working for a healthier environment reduces different threats on health, for example by environmental health promotion and environmental care (Nordenfelt, 2001).

### Personal and social responsibility for Health

Supporting Nordenfelt's (1991) theory that health includes an individual's abilities to act, the theory of personal and social responsibility for health has been considered. From an individual perspective, personal responsibility for health considers health and having a healthy lifestyle as something that is a personal choice and that an individual is in control over. These choices made can result in very different health outcomes (Wikler, 2002). In addition, individuals are seen as actors that act and choose freely, and thus stands responsible for the healthy or unhealthy choices they have made, and therefore also the health outcome. Considering the idea that an individual may suffer from a non-communicable disease due to poor lifestyle habits and unhealthy choices that the individual in fact is responsible for herself, can stand as an argument to fewer public resources given in order to combat non-communicable diseases on a societal level (Brown, 2013). In addition, it lessens the responsibility of public policies and general health strategies, since more responsibility is put on the individual (Wikler, 2002). From a wider perspective, health and a healthy lifestyle can be seen as a social responsibility, which covers socioeconomic reasons and factors linked to health. For example, it is known today that people with a higher socioeconomic status both live longer and have a healthier lifestyle (Wikler, 2002).

## Aim

The purpose of the study was to investigate how Guadeloupe handles the waves and beachings of the brown algae sargassum, as well as how the residents' health and lifestyle are affected.

## Method

The study has a case study design with qualitative content analysis and an inductive approach, to identify similarities and differences in the text content (Lindgren et al., 2020). The objective of the selected study design is to gain a greater understanding and knowledge of the case in depth, which served as the basis for the choice of design (Bryman, 2019). Data has been collected through ten semi-structured interviews with different local organisations operating in Guadeloupe. The interviews were conducted within a period of two months, from January to March 2023, and lasted on an average one hour. The semi-structured interviews have been the basis for later analysis work and the conclusion of the study. The study's interview guide has been tested and reviewed through a separate pilot study, in order to test the suitability of the interview questions for data collection. The basis for the study's data analysis has been the collected data, thus the study has had an inductive approach. The goal of the study has been to gain a deeper understanding about the researched topic (Bryman, 2019, Lindgren et al., 2020). In the study, a thematic analysis has been carried out. The data has been categorised into a few themes, which were chosen based on the study's research questions. The collected data has been processed through a coding process, where each identified sub-moment has been given a code. The codes have then been analysed, as well as the relationship and frequency between the different codes (Bryman, 2019).

## Ethical considerations

The study has been conducted and followed the ethical principles of the Declaration of Helsinki 2013 under the whole study process (WMA, 2023). Additionally, the study follows the requirements of proper research presented by the Swedish Research Council (2017). Considering that all informants have spoken on an organisational level about handling of sargassum and health and lifestyle factors on a general level for the island, this study has not investigated what can be considered vulnerable or personal data. Nevertheless, the study has handled all personal data conducted through the consent formularies according to the guidelines by the General Data Protection Regulation (IMY, 2021). The study has been carried out as a student work for a thesis and followed international guidelines for scientific articles, and thus not applied for ethical approval from the Swedish Ethical Review Authority (Swedish Research Council, 2017). Taken into consideration the association between ethics and the quality of research, the study's ethical considerations and approach have been carefully chosen and discussed with the supervisors for the student work (Swedish Research Council, 2017). During the data collection the informants have been instructed, both orally and in writing, about their ethical rights and the study's ethical guidelines. A written consent to participate in the study has been given before the held interviews. Additionally, the informants have been well informed that the participation is completely voluntary during the whole participation period. Thus, the

informants have been given the choice to end their participation in the study at any time. This choice has been possible to the informants to execute also without giving a reason.

## Results

The study's findings show no collaborative or sufficient strategy to handle sargassum, which leads to excess sargassum along the shoreline and on the beaches. As of today, sargassum is mostly collected on land, which is a method not supported by previous studies and is considered time-consuming (Resiere et al., 2023). The insufficient handling of sargassum leads to health consequences and hazards, namely due to the toxic gas released from sargassum piles during the decomposition process (de Lanlay et al., 2022, Resiere et al., 2023, Stephan et al., 2023). Furthermore, the study indicates that there is a knowledge gap among the inhabitants when it comes to awareness about sargassum. Health professionals demonstrated a lot of information and knowledge about sargassum and its impact on human health, however other informants mostly expressed a feeling of anxiety or fear due to lack of health information regarding the topic. Therefore, a general lack of both health information and health literacy could be indicated. Additionally, sargassum waves and beachings contribute to a limited access of different physical and leisure activities that can be performed. Therefore, the study's findings present sargassum having an impact on inhabitants' lifestyle. In addition, excessive sargassum leads to economic disadvantages and fishermen as a profession are in higher extent affected compared to other sectors (Resiere et al., 2023).

## Discussion of method

Originally directors of townhalls were thought to participate in the study, however there was a dropout. Thus, directors of local marinas were contacted and chosen instead. The marina bases in Guadeloupe were chosen, as they operate on locations greatly exposed to sargassum along the coastline and play a vital role for the tourism industry and several different leisure activities. Therefore, the marinas have an influence on some extent on lifestyle factors of people in Guadeloupe. Furthermore, the marinas collaborate with nautical schools and associations, thus promoting physical activity in form of different nautical activities.

An advantage of the study taking place in Guadeloupe has been that the geographical distances were short, since Guadeloupe is a relatively small island. Thus, it has been both time-efficient and possible to visit the various informants' workplaces, which has further provided a broader idea of the informants' operations. However, the fact that the study took place on an island has brought other obstacles, such as difficulties in contacting the informants, since power outages and poor signal are common issues on the island. Therefore, the process of contacting all informants to schedule an interview was a long process. Sometimes, it was even more time-efficient to directly visit the informant on site, instead of trying to get in touch in



advance through email or by phone. During the study's data collection, it has been fundamental to understand the local society, its structures and the culture. Methodological approaches that could have been used in mainland France, might not be as suitable for Guadeloupe. For example, having the interviews online could have brought a lot of risks, taken into consideration the frequency of power outages and poor internet signal on the island. In addition, a great understanding of the different operations and structures on the island has been crucial. Without this knowledge, it would have been extremely time consuming to know where to start, where to go and whom to contact and by which channels. Furthermore, one cannot forget the essential key for this study's conduction, that is sufficient knowledge in the French language. Without knowledge in French, an interpreter would absolutely have been needed, which would have raised the study's budget and made it more difficult to organise. Although some informants do have a satisfactory level in English, it has been an important access to be able to communicate with them in their own mother tongue. The use of the French language has further contributed to a relaxed and comfortable feeling during the interview situations, since the informants have been able to speak a language that they prefer. The voluntarism and willingness to participate in the study would probably also have been lower, in case the participants would not have been given this freedom.

The study's targeted selection has been growing from one informant to another, a form of *snowball sampling*. The sampling method was chosen in order to identify and find suitable participants for the study, since it would have been extremely time-consuming otherwise. Also, snowball sampling was a budget friendly option, since the study has been conducted with a very limited budget (Bryman, 2019). To give an example of the sampling process, local organisations were contacted by email, in order to ask for their willingness and interest to participate in the study. In some cases, the organisations responded affirmative, and a future meeting was planned. In other cases, organisations negated to participate, but gave contact details and advice about other organisations that would be more suitable, since these organisations for example possess a greater general knowledge of sargassum. The chosen sampling method has been time consuming, but still time efficient considered other sampling methods and their possible timeframes.

The participated informants in this study work and operate in areas highly exposed to sargassum. The areas have been identified by observations on site, as well as following forecast updates about incoming sargassum waves. The chosen focus on locations in Guadeloupe can be understood as having had an impact on the high level of willingness and helpfulness during the study process, since the informants and their operations are greatly exposed to sargassum. Further, the interviews were held from January to March 2023. This time period includes the yearly peak of incoming periodical sargassum in Guadeloupe, which begins in March (Bernard et al., 2022). Thus, the timing of interviews and data collection might have had an advantage of taking place during the specific time period during the year. Another geographical location and focus on a similar study could possibly

give a very different outcome, since participants might not find the study's purpose relevant. Since the collected data is based on personal experiences and knowledge, the same individuals would have to be contacted and interviewed in a similar environment and setting, in order to achieve similar study results (Bryman, 2019, Lindgren et al., 2020). The interviews would also have to be held in the same language as was done in this study, mostly in French, since an informant's possible poor language knowledge in another language can also be understood to affect the outcome of the interview.

## Discussion of results

As mentioned before, Nordenfelt (1991) presents an individual in good health as someone with the abilities to act, whereas an individual with poor health is a person with limited abilities and resources to act. This study's results indicates that sargassum exposure and beachings lead to limited access to leisure activities and possible physical activities, since areas where inhabitants can spend their time is limited. Considering Nordenfelt's (1991) theory on the concept of health, one can therefore argue that Guadeloupeans' health is negatively impacted by sargassum, since their abilities to act becomes limited. To continue Nordenfelt's (1991) theory, health information is all information that has a positive link to an individual's health status. The study's results indicate a lack of information among the inhabitants when it comes to sargassum exposure's health impacts and consequences. Although a professional expertise could be identified, a general anxiety and sense of fear was present. Therefore, a presence of limited health literacy can be argued. In this study the focus on the concept of a healthy lifestyle was on the key area physical activity (Green et al., 2019). The study's results indicate a limited diversity and access to physical activities and other leisure activities in general due to sargassum. Thus, the presence of sargassum can be stated to have an impact on inhabitants' lifestyle. Another key role of having a healthy lifestyle is health at work (Green et al., 2019). The study's results identified fishermen as a profession particularly affected by sargassum waves and influxes, which align with previous research findings (Resiere et al., 2023). Not only do they have limited areas where they can fish and operate, they are also more exposed to the toxic gas of sargassum due to their work being around the coastline. In addition, they are affected by an economic drawback, since more rapid engine decomposition and less caught fish (UNEP, 2021). Thus, the concept of health at work linked to a healthy lifestyle can be identified among the profession fishermen (Green et al., 2019).

During the data collection no sufficient or collaborative handling or strategy of sargassum could be identified. The handling methods presented by the informants were linked to health concerns or simply are not efficient enough, since the problem of excessive sargassum remains present. Regional initiatives seem limited and previous research state concerns about how sargassum influxes as a public health concern is left non prioritised (Resiere et al., 2023). One viewpoint could be that sargassum exposure and

health concerns is left to the individual alone, and that the issue is not looked at from a societal level and from a public health perspective. Considering the idea that an individual can manage the level of sargassum exposure and symptoms experienced by own will, this could be used as an argument to why the health concern of sargassum is left without priority and with fewer public resources given (Brown, 2013). However, this argument remains fragile, since sargassum exposure in many cases is not based on an individual's choice, for example people working in areas affected by sargassum beachings or living in coastal cities highly affected by the toxic gas during the decomposition process (Resiere et al., 2023, UNEP, 2021).

The study's findings suggest that general health information about sargassum is lacking, and the health literacy is poor. In addition, the study suggests that these factors as well as exposure to sargassum affect the lifestyle of the inhabitants in a negative way, for example due to a smaller range of physical activities available to practice, grown anxiety levels and areas to spend leisure time becoming limited. Another possibility is that inhabitants' lifestyle is in fact affected by something else, for example the concept of personal and social responsibility for health (Wikler, 2002). With taking this viewpoint into account, one could suggest that inhabitants in Guadeloupe have their own personal will and choice in order to achieve maximal health status and a healthy lifestyle. However, as presented earlier, social responsibility for health covers socioeconomic reasons and factors linked to health. Therefore, Guadeloupe's more fragile and weaker socioeconomic status compared to mainland France could also be one reason why inhabitants to a greater extent experience negative health outcomes or consequences linked to lifestyle factors (ARS, 2018). This further would be applicable to WHO's (1998) statement that both economic and socioeconomic factors affect lifestyle.

Another possible argument for the study's findings, such as lack of health information and health literacy, decreased physical activity and experienced anxiety due to sargassum exposure, might in fact be linked to the island's legacy of slavery. According to previous research, Guadeloupeans still today experience health and lifestyle disadvantages caused by slavery, which took place on the island from year 1644 to 1848 (Ganem, 2023). Inter-family violence and social conflicts at work have been stated as factors linked to the legacy of slavery, which have namely contributed to mental health disorders. Further, a general reluctance to work for another individual than oneself is present still today (Ganem, 2023). Considering WHO's (1998) and Green et al. (2019) viewpoints that both economic and socioeconomic factors, as well as experienced health at work contribute to lifestyle, one can argue that the concerns of the legacy of slavery might in fact also contribute to the lifestyle and health findings of this study. For example, the experienced anxiety about sargassum exposure might in fact partly be present due to other factors. Furthermore, Guadeloupe has a troublesome history of environmental health and toxins found in the surrounding environment, of which the most known pesticide is chlordecone (Coat et al., 2011, Kadhel et al., 2014, Multigner et al., 2016). Sargassum seaweed's health hazardous properties and toxic gas H<sub>2</sub>S can be argued to remind one of the health issues caused by chlordecone. Thus, sargassum

exposure might cause stronger reactions among the inhabitants, namely fear and anxiety of the uncertain, unmanaged and still unspecified health outcomes.

Today, a collaborating system and concept called *One Health* is promoted in order to combat future health challenges and risks (Lefrancois et al., 2023). The concept of One Health can be defined as a collective cross-curricular attempt to improve health for all living species, and it aims to work and operate on a global level, and it is a policy set by the European Commission for Global Health Strategy (Aguirre et al., 2016, Viberg et al., 2023). Furthermore, climate change and its impact on health is not limited to only one nation or continent, it is worldwide. Since growing sargassum waves are associated with climate change and is stated to be a public health concern, one can argue that a common health system such as One Health would be beneficial. In addition, a general and global systematic plan to approach and collect sargassum in the Caribbean was also something researchers Resiere et al. (2023) mentioned as needed. During the study no common plan or mission in approaching sargassum could be identified in the Caribbean or for Guadeloupe. However, the islands do share ideas and inspiration of efficient methods to collect sargassum. For example, Guadeloupe's neighbour island Martinique was mentioned during interviews as having more variety in how sargassum is managed and collected. Not only does Martinique have more physical machines to collect sargassum efficiently, but the island also has innovative structures in order to let the sargassum pass and limit how much sargassum reaches the land. There is a way to limit sargassum that reaches the marinas and beaches by building blocks along the entrance to the marina so that boats can pass, but sargassum cannot. This solution has its limits, since it is not fitted or even possible to construct in all marinas or along all beaches. However, this solution would minimise sargassum that reaches the land, which in turn would lessen the sargassum needed to be collected within a certain time on land. Although the construction would be a financial investment, it could later lead to economic benefits, since less sargassum must be collected (UNEP, 2021). Additionally, less sargassum on land would also lead to less decomposition of sargassum, which means less toxic gas and thus less health hazards (Stephan et al., 2023, UNEP, 2021). Further, inhabitants' lifestyle would be positively impacted, since beaches would be open again and a greater variety of physical activities and leisure activities would be available (Nordenfelt, 1991).

In addition, the WHO promotes a circular economy instead of a linear economy for a sustainable future associated with UN's global goals and Agenda 2030 (UN, 2023). A circular economy can be defined as an economical concept that is based on the idea of sharing, remaking and renewing resources, instead of disposal and overconsumption. According to WHO, a circular economy enables both health and sustainable growth, while preserving the environment and its resources (WHO, 2018). Therefore, this study's findings associated with WHO's statements recommends an attempt for Guadeloupe to work for transitioning to a circular economy. Further, the use of sargassum can be seen as a way of

economic development in the Caribbean (UNEP, 2021). Supporting the idea of renewing and remaking resources, different entrepreneurial attempts have taken place in the Caribbean during the past years. For example, freshly collected sargassum in the ocean can be used for developing eco-friendly cosmetics, textile fabrics and nutrition for livestock (Aussedat, 2023, Klingberg, 2023, UNEP, 2021). These new findings of how sargassum can be reused in several ways does not only give hope for the future, but also supports UN's Global Goals and Agenda 2030 (UN, 2023). To name one product, eco-friendly and non-toxic sunscreen can be developed from sargassum. This sunscreen product is also nonharmful for the coral reefs (Origin by Ocean, 2023). Therefore, remaking a resource to something new that is both beneficial for human health and the environment can be seen as following the idea of One Health and giving hope for a brighter future. In addition, this study's findings suggests that the concept of environmental health promotion by Nordenfelt (2001) would be beneficial. According to Nordenfelt (2001) the surrounding environment can be seen as providing opportunities to practice a certain action or not. Since sargassum affects the surrounding environment and later delimitates both areas and activities which can be practiced, one can state that sargassum waves and beachings limits the practice of certain actions. The concepts of health-enhancing and health promotion are recommended in order to work for better health overall, in situations where environmental factors produce health consequences (Nordenfelt, 2001). Although innovative ideas of reusing sargassum exist today, UNEP (2021) states that the presence of sargassum beachings should be seen as a health hazard, rather than an opportunity. However, in the future the situation can be very different when the use and utility of sargassum seaweed have been determined in a broader scale.

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