The socio-cultural value of the Simpson Bay Lagoon

An economic valuation amongst the heterogeneous population of Saint Martin

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Contents

List of abbreviations

ESS	Ecosystem Services
MEA	Millennium Ecosystem Assessment
TEEB	The Economics of Ecosystems and Biodiversity
CE	Choice Experiment
CV	Contingent Valuation

Abstract

The Simpson Bay Lagoon provides an important ecological value, as well as numerous ecosystem services to the community of Saint Martin. However, the lagoon has been heavily polluted for many years. The aim of this study is to analyze how the socio-cultural context of the community of Saint Martin determines the value of the ecosystem services provided by the Simpson Bay Lagoon. This will show the ecological and societal importance of maintaining and restoring the lagoon and will give insight into which services are relevant to different stakeholders and which trade-offs need to be taken into account by decision-makers. A survey including a choice experiment and a contingent valuation was the main data collection method in this research. The choice experiment was analyzed with a random parameter logit model, the socio-cultural background was analyzed with one-way ANOVA, Spearman Correlation and regression analyses. From the results of this research can be concluded that different factors of the socio-cultural context determine the appreciation of ecosystem services delivered by the Simpson Bay Lagoon, such as some demographic variables (especially education level), the different constituents of well-being, the participation in recreational activities and environmental behavior and awareness. The results of this study will contribute to effective targeting of strategies to engage the public in improving the environmental quality of the Simpson Bay Lagoon. In addition to showing the societal value of the Simpson Bay Lagoon to decision makers.

1. Introduction

Coastal lagoons are ecosystems that are common along coastlines worldwide (Barnes, 1980). Kjerfve defines a coastal lagoon as: “a shallow coastal water body separated from the ocean by a barrier, connected at least intermittently to the ocean by one or more restricted inlets” (Kjerfve, 1994, p.5). These shallow water bodies are highly productive ecosystems (Alongi, 1998) wherein many biogeochemical processes take place (Sousa, Lillebø, Gooch, Soares, & Alves, 2013). Furthermore, coastal lagoons provide important habitats, such as seagrass pastures, wetlands, mangroves and sometimes coral reefs (Basset, Elliott, West, & Wilson, 2013), that provide support to abundant biodiversity, including different kinds of fish, birds and shellfish (Pérez-Ruzafa et al., 2011). The moderate conditions within lagoons provide security for many (endangered) species and are often used by them for nursery and feeding (Franco et al., 2006).

Not only do coastal lagoons provide an important ecological value, also humans benefit from the numerous ecosystem services (ESS) provided by coastal lagoons (Newton et al., 2014). The concept of ESS has increasingly been used in academics and policy-making (Fisher, Turner & Morling, 2009; Lamarque, Quetier & Lavorel, 2011). The Millennium Ecosystem Assessment (MEA) defines ESS as: “the benefits people obtain from ecosystems and biodiversity” (Assessment ME, 2005). Coastal lagoons provide numerous valuable ESS of which examples are food provisioning, water purification, climate regulation, oxygen production, flood protection, recreation and ecotourism (Lopes & Videira, 2013; Newton et al., 2018). Furthermore, some of these services, in particular food provisioning, recreation and tourism are important contributors to local economies (Newton et al., 2014). Hence, due their ecological importance in addition to the valuable ESS that coastal lagoons provide, their preservation is of paramount importance.

This research will focus on the Simpson Bay Lagoon, the largest wetland on the island of Saint Martin. The Simpson Bay Lagoon has an important ecological function. Seagrasses and mangroves can be found in and around the lagoon, which provide habitat to a wide range of biodiversity, such as many reef and pelagic fish (Lips & Slooten, 2009). However, the Simpson Bay Lagoon has been heavily polluted for many years. The area surrounding the lagoon is intensively used for human activities. Environmental regulations are lacking or not enforced, resulting in land reclamation, sewage run-off, illegal waste disposal, wrecks, boating and marina activities, which all contribute to the pollution of the lagoon (Lips & Slooten, 2009). Especially the degree of sewage pollution is high. A study on the water quality of the lagoon shows that the samples of nearly all studied sites were contaminated with bacteria originating from unmanaged sewage (Borch, 2002). The seagrasses and mangroves that are present in the lagoon are particularly vulnerable to pollution. As a result of the high levels of pollution and the rapid coastal development, it has been estimated that 80% of the original seagrass and biodiversity has been diminished and that all mangrove forest are threatened by pollution and over-development (Nature Foundation St. Maarten, 2013). Stakeholder surveys indicated that the lagoon was once surrounded with beaches and mangrove forests, which were largely removed for the development of coastal real estate (Gilders, 2018). Even though the lagoon is heavily polluted, areas such as Mullet Pond still retain an important ecological function, by contributing to biodiversity and ecosystem services. Therefore, it is expected that the lagoon

still provides an important value to the community of Saint Martin, also in economic terms. Important ESS delivered by the lagoon are food provisioning, flood protection, recreation and tourism (Gilders, 2018).
The aim of this study is to analyze how the cultural context of the community of Saint Martin determines the value of the ESS delivered by the Simpson Bay Lagoon. Involvement of society into the management of ecosystems is of major importance as humans are an inseparable part of ecosystems and their actions directly influence the delivery of ESS (Chan et al., 2016). Valuing the ESS delivered by the lagoon will facilitate communication of the ecological and societal importance of maintaining and restoring the lagoon to different stakeholders and in particular to decision-makers (Bouma & van Beukering, 2015). Furthermore, investigating the socio-cultural context that determines these values will give insight into why the community of Saint Martin values the ESS delivered by the Simpson Bay Lagoon the way they do. This insight is important in the decision-making regarding nature conservation, as it will show which services are relevant to different stakeholders and which trade-offs need to be taken into account (Seppelt et al., 2011). Hitherto, the main research focus in the field of ESS has been on the biophysical capability of ecosystems to provide ESS, or on the ESS of these services (Newton et al., 2018; World Resources Institute, 2019). Though, little attention has been drawn on the influence of cultural context towards appreciation of ESS, taking into account human values, beliefs and attitudes (Vihervaara, Rönkä & Walls, 2010). So far, the ESS, their respective values and the cultural context that determines these values of the Simpson Bay Lagoon have not been extensively investigated.

1.1 Research question

The research question addressed in this paper is as follows:
How does the cultural context of the community of Saint Martin influence the appreciation of ecosystem services provided by the Simpson Bay Lagoon?

Research sub-questions

(i) How is the appreciation of nature embedded in the valuation of ecosystem services provided by the Simpson Bay Lagoon?
(ii) In what way does an individual versus a collective attitude towards ecosystem services delivered by the Simpson Bay Lagoon determine the appreciation of these services?
(iii) In what way does the stated environmental behavior of the community of Saint Martin determine their appreciation of the services provided by the Simpson Bay Lagoon?
(iv) How do different constituents of well-being relate to the appreciation of ecosystem services delivered by the Simpson Bay Lagoon?

The structure of this thesis is as follows: chapter 2 describes the contextual background of this study. Chapter 3 provides the conceptual and theoretical framework that structures this research. Thereafter, in chapter 4, the methods that were used in this research are described. Chapter 5 provides an overview of the results that were obtained in this research. Lastly, chapter 6 draws conclusions from the obtained results, compares them to academic literature and provides policy implication and recommendations for further research.

2. Contextual background

Saint Martin is an island located in the Eastern Caribbean. The island is divided into a Dutch part (Sint Maarten), situated on the southern-side of the island, and a French part (Saint Martin), situated on the northern-side. The total area of the island is 86 km^2, of which the Dutch portion makes up 34 km^2. In 2017, the Dutch side had a total population of 40,535 inhabitants (Department of statistics Sint Maarten, 2017), the French side had a total population of 35,746 inhabitants in 2016 (city population, 2016) . The Dutch part has been part of the Netherlands Antilles for more than 50 years until October 10th, 2010, when it became a constituent country within the kingdom of the Netherlands. It now how its own government and parliament but the Dutch Kingdom remains in charge of defense and foreign affairs. The French part was part of the department of Guadeloupe until 2007, but is now a French overseas collectivity, but is still part of the European Union (City population, 2016). Ecologically speaking, Saint Martin is an exception in the mostly dry area of the eastern Caribbean as it contains expansive wetlands, such as the Simpson Bay Lagoon and other wetlands (Brown & Collier, 2002). The focus of this research is on the ESS provided by the Simpson Bay Lagoon.

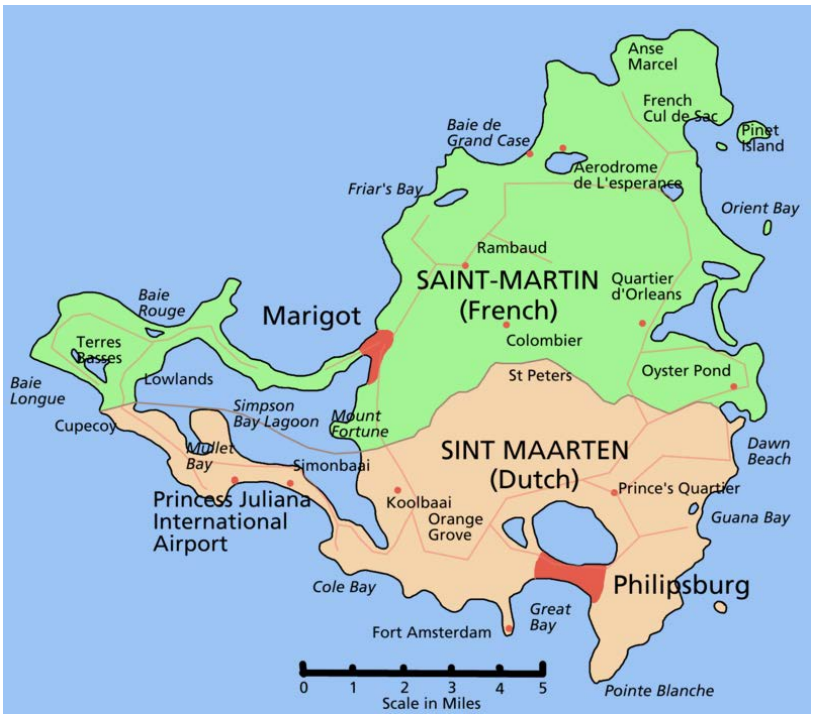

Figure 2.1: Map of Saint Martin

3. Concepts and theories

The following chapter will explain the conceptual framework that was used to structure this research. Furthermore, it will provide the theory behind the different concepts used in the framework.

Constanza et al. was the first to introduce the currently commonly used concept of ESS, by explaining the societal value produced by ecosystems through ecosystem service delivery (Constanza et al., 1997). Thereafter, the MEA expressed the need to protect ecosystems and biodiversity by valuing their benefits to society in terms of ESS. The MEA defines ESS as: "the benefits people obtain from ecosystems and biodiversity" (Assessment ME, 2005). The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative that followed up on the work of the MEA by focusing on showing the values of nature in order to get their relevance and importance acknowledged in decision making at all levels (The Economics of Ecosystems and Biodiversity, 2019). The TEEB framework was created to provide a structured approach to the valuation of ESS, which is very relevant to the current study as well. To assess the value of the most important ESS of the Simpson Bay lagoon, a framework was designed based on the TEEB framework. This framework includes the following aspects: ecosystems and biodiversity (divided by functions and ecological structures and processes), ecosystem services, human well-being, governance and decision-making and direct, indirect and external drivers. The framework, adapted to the context of this study is illustrated in Figure 3.1. The blocks in white are the aspects that are specifically studied in this research. This study uses a quantitative approach with a survey as the main data collection method. This research will focus on the ESS flood protection, habitat for species, recreation and tourism. These ESS will be valued my means of a Contingent Valuation and a Choice Experiment. This will be further elaborated on in the method section. Furthermore, the constituents of well-being, appreciation of nature, environmental behavior and awareness and individual versus collective attitude will be part of the survey questions. Also the support for different policy options will be questioned in the survey. Ecological structures and processes, functions and indirect and external drivers are studied by means of literature review. The theory behind the different concept used in this framework will be further elaborated on later in this chapter.

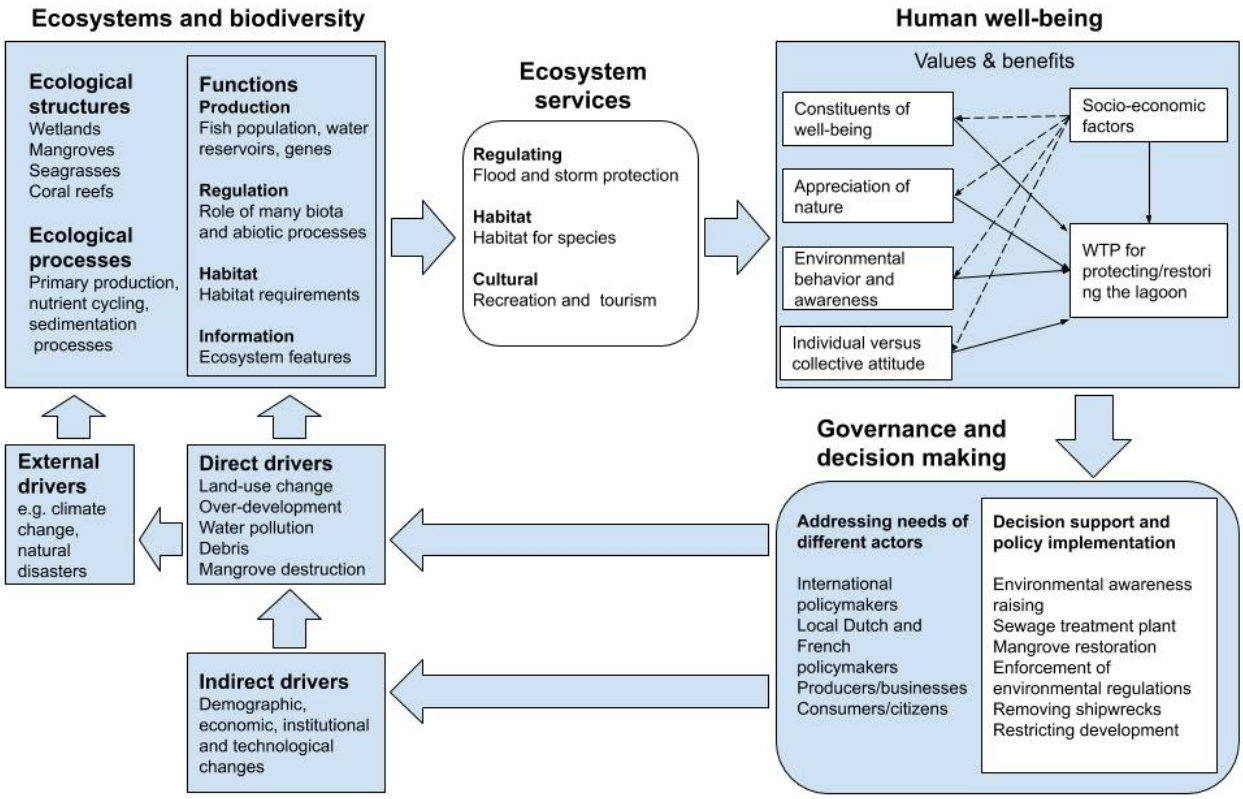

Figure 3.1: Conceptual framework inspired by TEEB (The Economics of Ecosystems and Biodiversity, 2019)

3.1 Ecosystem goods and services

A previous investigation already provided an overview of all ESS delivered by the Simpson Bay Lagoon, which can be found in Table 1. Furthermore, the focus group discussion that were held in that investigation also indicated which ESS were most important (Gilders, 2018). Based on this research, the following ESS were chosen as the focus of this research: flood protection, tourism and recreation and habitat and biodiversity. They will be further elaborated on in this chapter.

3.1.1 Flood protection

Saint Martin is located in an area that is prone to hurricanes, tropical storms and depressions (Government of Sint Maarten, 2018). In 2017, hurricane Irma hit the island, causing extensive damage to the island, its infrastructure and its nature and environment (Nature Foundation Sint Maarten, 2017). Small Island Developing States (SIDS), like Saint Martin are particularly vulnerable to extreme weather events, due to their economic vulnerability (i.e. their limited number of economic activities and high dependence on imported goods), social vulnerability (i.e. high levels of crime and corruption and low socio-economic status of the population) (United Nations Sustainable Development, 2008). Climate change may increase the frequency of extreme weather events, affecting SIDS. Furthermore, SIDS are highly vulnerable for other effects of climate change such as sea level rise and acidification, which are expected to impact coastal lagoons directly (Anthony et al., 2009).

One of the most important ecosystem service provided by coastal lagoons is flood protection (Lopes & Videira, 2013; Newton et al., 2018). Mangrove forest and coral reefs are biophysical structures that contribute greatly to flood protection (Ewel, Twilley & Ong, 1998). In the past, the Simpson Bay Lagoon was surrounded by sand beaches and mangrove strands. Nowadays, due to over-development and pollution of the lagoon, only few mangrove strands are still present (Gilders, 2018). Furthermore, the coral reefs that are in close proximity to the lagoon contribute to flood protection of the area, however, these reefs are also threatened by degradation due to mismanagement and pollution (Gilders, 2018; Burke, Maidens, Spalding, Kramer & Green, 2004). Therefore, restoring and maintaining mangrove forest and coral reefs is of paramount importance to protect the community of Sint Maarten from flooding during extreme weather events.

3.1.2 Tourism and recreation

The tourism sector accounts for the most important source of income of Sint Maarten, both in terms of GDP and employment (Department of statistics Sint Maarten, 2017). The Simpson Bay Lagoon is an important contributor to the tourism sector and recreational value of Sint Maarten for different reasons. First of all, the lack of open ocean swells combined with the large size of the lagoon makes the lagoon a perfect location for a safe harbor, which is why Sint Maarten is one of the main marine destinations of the Caribbean (Port St. Maarten, 2019). This harbor also provides shelter to smaller boats during extreme weather events. Furthermore, as Saint Martin is one of the few islands in the Eastern Caribbean containing expansive wetlands like the Simpson Bay Lagoon, the lagoon provides a unique and aesthetically attractive landscape that differentiates Saint Martin from other islands in the area (Brown & Collier, 2002). Additionally, the lagoon provides opportunity for numerous recreational activities, such as swimming, snorkeling, diving, fishing and birding, that are mostly enjoyed by short and long-stay visitors of the island. Also numerous businesses are located around the lagoon, such as hotels, restaurants, shops and resorts. The spill-over sewage that enters the lagoon causes bad smell and itchy skin when coming in contact with the water of the lagoon. This might have a negative effect on the attractiveness of the lagoon, resulting in a decline in tourist activities. Restoring and maintaining the lagoon might have a positive influence on the tourism sector of the island thereby benefitting the inhabitants of Saint Martin.

3.1.3 Habitat and biodiversity

The Simpson Bay Lagoon influences four distinct types of habitats, which contain a variety of biodiversity. These habitats include the wetland itself (containing different types of birds and fish, turtles, rays, crabs and shrimps), mangrove strands (containing different types of fish, crabs and juvenile fish), seagrass pastures (containing different types of crustaceans and invertebrates) and coral reefs (containing a wide variety of fish, turtles etc.) (Kippy Gilders, 2018). The wetland of the Simpson Bay Lagoon is an important nursery ground for fish and other species. The roots of mangroves and seagrass pastures provide a safe area for different fish to grow without the risk of predators. Also, the lagoon provides protection against extreme conditions, due to the lack of open ocean swell. Mature fish migrate to the surrounding coral reefs where they contribute to the reef ecosystem that is enjoyed for recreation by swimmers and divers. Furthermore, a healthy fish population contributes to the food provisioning of the community of Saint Martin (Gilders, 2018).

Table 1: Overview of all ESS *provided by the Simpson Bay Lagoon (Gilders, 2018)*

System	Services	Uses	Specification
Wetland	Provisioning	Food	Fishing for food and bait
	Regulating	Local climate and air quality	Keeping surrounding area 'cool'
		Carbon sequestration/storage	
		Moderation of extreme events	Flood prevention, safe harbor for yachts
		Wastewater treatment	Purification of water runoff
		Erosion control	
		Pollination	Birds pollinate nearby trees etc.
	Habitat	For species	Birds, fish, turtles, rays, crabs, shrimps, etc.
		Genetic diversity	
		Nursery ground	
	Cultural	Recreational	Swimming, sailing, kayaking
		Tourism	Marine industry, hotels, restaurants, eco-tourism
		Aesthetic	
		Education	Tours and activities through NGOs, eco-tourism
		Spiritual	Spiritual value to community
		Historical	Historical value to community
Mangroves	Regulating	Erosion control	
		Carbon sequestration	
		Waste water treatment	Purification of water runoff
	Habitat	For species	Birds, juvenile fish, crabs
		Nursery ground	
	Cultural	Recreation	Kayaking, birding, etc.
		Tourism	Eco-tourism
		Education	Tours and activities through NGOs, eco-tourism
Seagrasses	Regulating	Carbon sequestration/storage	
		Waste water treatment	Purification of water runoff
	Habitat	For species	Crustaceans, invertebrates, etc.
		Nursery ground	
Coral reefs	Provisioning	Food	Artisanal fishing of fish, invertebrates, etc.
	Regulating	Carbon sequestration/storage	
		Moderation of extreme events	Dissipate waves from storms and hurricanes
	Habitat	For species	Fish, turtles, etc.
	Cultural	Recreational	Swimming, snorkeling, diving, fishing, etc.
		Tourism	
		Aesthetic	
		Education	Tours and activities through NGOs, eco-tourism
		Historical	Historical and artisanal fishing

3.2 Well-being

The terms quality of life and well-being are increasingly used in the academic context. However, a consistent definition of these terms does not exist, which makes them rather vague. A widely accepted definition of quality of life is the one by Constanza et al. (2007): "Quality of life is the extent to which objective human needs are fulfilled in relation to personal (or group) perceptions of subjective human well-being (Constanza et al., 2007). The WHO defines quality of life as: "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (WHO, 2019). Furthermore, the terms quality of life and well-being are often used in the context of health- and health-care related issues, even though one would expect that these terms would apply to every individual, whether they are in good health or not.

This study will, amongst other things, focus on the relation between nature (in particular the ecosystem of the Simpson Bay Lagoon) and human well-being. Different studies found that spending time in nature has a positive effect on individual's well-being, as it can reduce stress and negative emotions like feeling sad or anxious, whereby it can also have a positive effect on a person's health (University of Minnesota, 2014.

The MEA designed a framework that links ESS and different constituents of well-being (MEA, 2003). The framework shows that changes in different types of ESS (supporting, provisioning, regulating and cultural ESS) can have an effect on the different constituents of well-being. The MEA defines well-being as a term consisting of different constituents that are dependent on situation, geography, cultural and ecological context:

- Security *(including personal safety, secure resource access and security from disasters)*
- Basic material for good life *(including adequate livelihoods, sufficient nutritious food, shelter and access to goods)*
- Health *(including strength, feeling well and access to clean air and water)*
- Good social relations *(including social cohesion, mutual respect and the ability to help others)*
- Freedom of choice and action *(the opportunity to be able to achieve what an individual values doing and being)*

These constituents of well-being will be used in this research to grasp the relationship between human well-being and ESS in the context of the Simpson Bay Lagoon.

3.3 Appreciation of nature

The ecological value versus the human benefit that ecosystems provide is related to the ongoing debate of why nature should be conserved. This debate roughly consists of three fronts: those who argue that nature should be conserved for its own sake (intrinsic value), those who argue that nature should be conserved because of its benefit to human beings (instrumental value) and those who argue nature should be protected because of its cultural and historical value (relational value) (Diaz et al., 2015). The concept of ESS is highly focused on the benefit of nature to humans. In this study, it will be investigated in what way the community of Saint Martin values nature (in terms of intrinsic, instrumental or relational value) and how this relates to the appreciation of the delivery of ESS provided by the Simpson Bay Lagoon. In the case of the Simpson Bay Lagoon, the intrinsic value of nature itself does not seem to be an incentive for preserving the ecosystem, as it is currently in a highly polluted state. However, the potential trade-off

between the intrinsic, instrumental and relational value of nature might explain the social context of the appreciation of the ESS of the Simpson Bay Lagoon.

3.4 Environmental behavior and awareness

It can be questioned why people would participate in environmentally friendly activities. Most of these activities, such as donating money to an environmental cause, purchase environmentally friendly products or recycling waste will benefit the common good but do not directly benefit the individual that performs the activity. This contradicts with the neoclassical paradigm of consumer choice, because this theory assumes that consumers always maximize their utility. However, a trend can be observed towards more environmental awareness or green consumerism (OECD, 2019). This conflicting trend with the neoclassical consumer choice paradigm may be explained by the concept that certain environmentally friendly activities are perceived as a necessary contribution to the public good or as a way to live up to social expectations (Kipperberg, 2006). Also, participating in environmentally friendly activities might give people the feeling that is often described as 'a warm glow of giving'. Meaning that people might feel good about themselves when practicing certain behavior, which can be seen as a way of deriving utility (Liebe, Preisendörfer & Meyerhoff, 2011).

To get more insight in the environmental behavior of the community of Saint Martin, participation in environmentally friendly activities was included in this research. The socio-cultural background of the respondents that show high participation in environmentally friendly activities was also be explored. This insight might give a further understanding in which groups in society can be further stimulated in their environmental behavior. Also, it will be explored if positive environmental behavior is related to the appreciation of ESS. Furthermore, it will be investigated whether people that consider themselves more environmentally aware value ecosystems more and participate more in environmental activities. Classical attitude-behavior paradigm assumes that behavior can be predicted by attitudes (Liebe, Preisendörfer & Meyerhoff, 2011). Therefore, it is to be expected that participation in environmental behavior or self-stated environmental awareness will have a positive influence on the WTP for the ESS delivered by the Simpson Bay Lagoon.

3.5 Individual versus collective attitude of ecosystem services

The polluted Simpson Bay Lagoon can be seen as an example of a tragedy of the commons, a concept that describes a situation where common-pool resources are being exploited by individual actors for their own self-interest (Hardin, 1968). Environmental destruction of the lagoon started when the economic potential of the Simpson Bay Lagoon was recognized by investors, resulting in the development of resorts and a large marine harbor causing destruction of the important ecological features of the lagoon, such as mangrove strands. Due to the high levels of pollution in the lagoon and the destructed ecological features, ESS potentially delivered by the lagoon may not be optimally provided to the community of Saint Martin. Adequate management to protect the common-pool resource of the Simpson Bay Lagoon is lacking. According to Elinor Ostrom, common-pool resources do not necessarily have to be over-used and destructed in the long run (Ostrom, 2015). With her work she shows that when common-pool resources are commonly used by small, local communities, rules will be established about how the resources should

be cared for and used in a way that is economically and ecologically sustainable (Ostrom, 2015). Her theories may be applicable when finding an adequate solution for the management and protection of the Simpson Bay Lagoon. Moreover, this research will investigate whether the community of Saint Martin approaches their attached value of the ecosystem services delivered by the lagoon from an individualistic or a collective point of view. This insight might explain if the Simpson Bay lagoon is an example of the tragedy of the commons and the current mismanagement of the lagoon.

4. Method

This chapter will explain the methodological approach that was used to investigate how the socio-cultural context of the community of Saint Martin determines the value of the ESS delivered by the Simpson Bay Lagoon. The data used in this study was collected through a household survey.

Figure 4.1 shows the methodological framework that was used in this study. This study was executed in the following steps: designing the survey, data collection and data analysis. This methodology chapter is structured by following this framework.

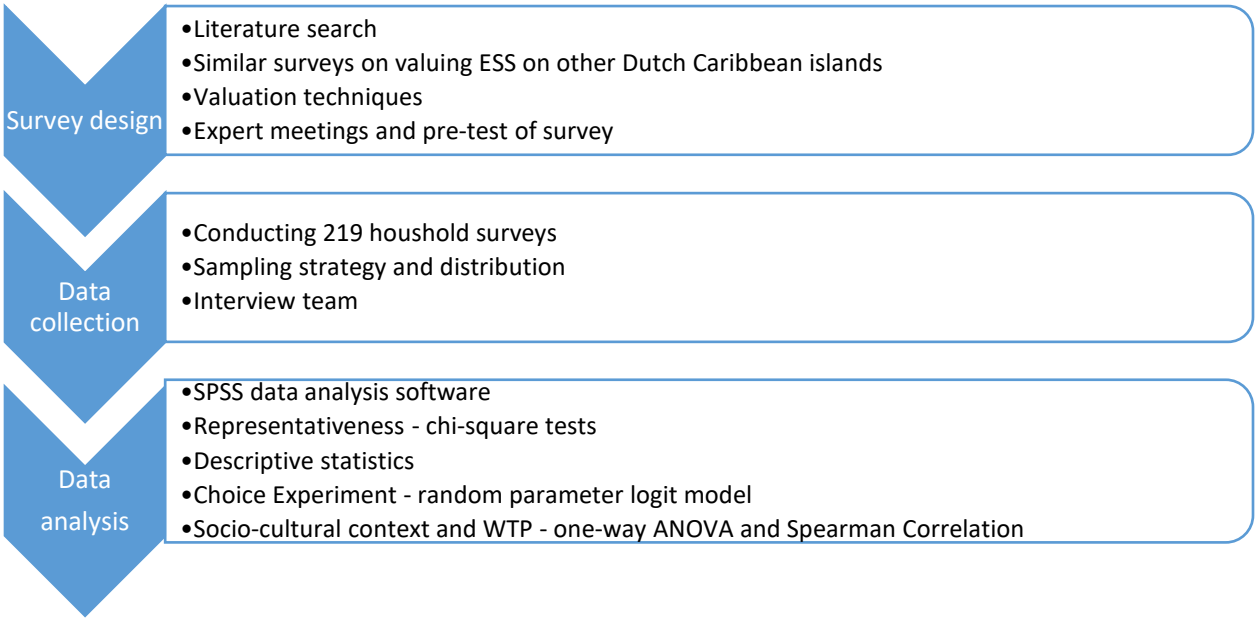

Figure 4.1 Methodological framework of this study

4.1 Survey design

The survey that was used to collect the data of this study was designed based on similar studies that were conducted on other islands in the Caribbean (IVM, 2012; IVM, 2017) and additional literature, (e.g. MEA, 2003). This study makes use of two different stated preference techniques to value the ESS provided by the Simpson Bay Lagoon; a Choice Experiment (CE) and a Contingent Valuation (CV) question accompanied by payment card format. These were the most appropriate methods to value the ESS provided by the Simpson Bay Lagoon, as these services do not have a market price and there was also no behavior to be revealed. These two stated preference methods will be further elaborated on later in this methodology chapter.

The final version of the survey can be found in annex I. It consisted of 39 questions divided in six different sections:

(i) Socio-demographic characteristics of the study population
(ii) Recreational activities on the lagoon
(iii) Environmental condition of the lagoon
(iv) Management activities
(v) Appreciation of nature
(vi) Environmental awareness and behavior
(vii) Economic valuation of ESS (including a choice experiment and contingent valuation)

4.1.1 Choice Experiment

A CE was chosen as one of the methods to measure the study population's value of the relevant ESS. CE has shown to be a reliable method to estimate the value of non-market goods and services, in particular when measuring changes in environmental quality (Boxall, Adamowica, Swait, Williams & Louviere, 1996). A CE is a type of survey that describes ecosystem goods and services as attributes that vary in levels. A payment vehicle must be included as one of the attributes. By giving the respondents different sets of choices with different levels of the included attributes that form hypothetical scenario's, it can be evaluated how respondents value these different goods, by looking at the trade-offs they make (Bouma & van Beukering, 2015). A CE differs from other non-market valuation methods, such as CV, as it asks participants to select between a set of alternative scenarios, rather than asking directly for values of ESS (Bouma & van Beukering, 2015).

Figure 4.2 gives an overview of how the CE was designed and validated. The first step in designing the CE was to assign attributes. A previous investigation made an inventory of all ESS provided by the different ecological systems of the Simpson Bay Lagoon (Table 1). Based on this previous research and on literature review the most relevant attributes and levels were selected (see preliminary choice card in annex II). Thereafter, expert meetings were held to confirm if the selected attributes and their respective levels were applicable and relevant to the local context. Amongst the experts were members of local environmental organizations, and employees of the environmental department of the government of Sint Maarten (VROMI) (Annex III give a more comprehensive overview of these expert meetings). The main outcome of these expert meetings was leaving out the attribute fisheries, as this aspect was already covered by the attribute suitability for recreation. Also the attribute flood protection was changed into damage from storms and the attribute biodiversity was changed into habitat for species. Furthermore, the levels of the payment vehicle were slightly adapted.

When the final attributes and levels were obtained, the statistical design of the CE was created by M. Koetze. A d-efficient design was chosen as the most appropriate design for this study. This design was chosen, because a standard factorial or fractional factorial design would require a large population sample which was not feasible within the time scope of this research.

Then the survey including the CE was piloted amongst a sample of the population of Saint Martin. A qualitative approach was chosen to pilot the study, meaning that respondents were interviewed following the survey guidelines and were also asked whether they could think of possible improvements on the attributes and levels of the choice card and on the wording of the questions.

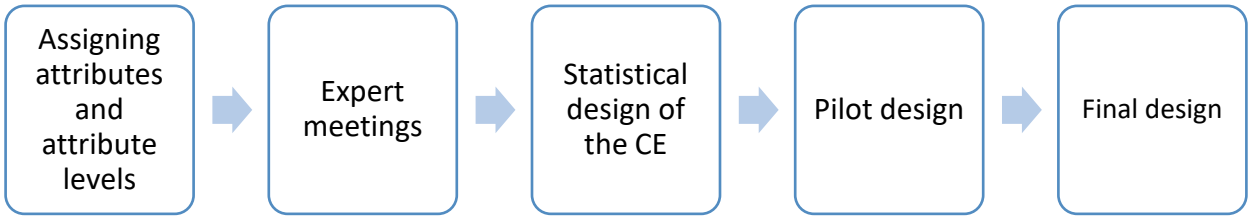

Figure 4.2. Process of designing the Choice Experiment

Finally, the following attributes were chosen to value the most important ESS of the Simpson Bay Lagoon in the CE: damage from storms, water quality, habitat for species, suitability for recreation, the amount of stay-over tourists and a monthly contribution. They will be further explained below.

(i) *Damage from storms* refers to the damage from storms to properties nearby the lagoon. Mangroves around the lagoon provide important protection from storms.
(ii) *Water quality* refers to the quality of the water in the Simpson Bay Lagoon. This takes into account the clarity of the water and the smell of the water.
(iii) *Habitat for species* refers to the extent to which the lagoon can provide a habitat for species (fish, turtles, birds, etc.). Many species find a habitat in the seagrass beds and mangrove strands that are present in the lagoon.
(iv) *Suitability for recreation* refers to the suitability of the lagoon for recreational activities (fishing, sailing, swimming, barbecuing, bird watching, kayaking, kitesurfing, windsurfing, water skiing, etc.).
(v) *Stay-over tourists* refers to the number of stay-over tourists that come to the island of Saint Martin.
(vi) The *contribution per month* that would be contributed financially by all households of Saint Martin and would be used strictly for the environmental management of the Simpson Bay Lagoon.

The results of the CE provide the willingness to pay (WTP) of the residents of Sint Maarten for the different attributes, as well as the total WTP for the environmental management of the Simpson Bay lagoon. The different levels of the attributes are shown in Table 4.1 below.

Table 4.1: Attributes and levels for the choice card

Attribute	Level 1	Level 2	Level 3	Level 4	Level 5
Damage from storms	40% more damage	No change	20% less damage	40% less damage	
Water quality	Low; bad smell and unclear water	Moderate; occasional bad smell and areas of clear and unclear water	High; clear water and no bad smell		
Habitat for species	40% less habitat	No change	20% more habitat	40% more habitat	
Suitability for recreation	Low	Moderate	High		
Tourism	20% less stay-over tourists	No change	10% more stay-over tourists	20% more stay-over tourists	
Annual contribution	$0	$24 ($2 monthly)	$60 ($5 monthly)	$120 ($10 monthly	$240 ($20 monthly)

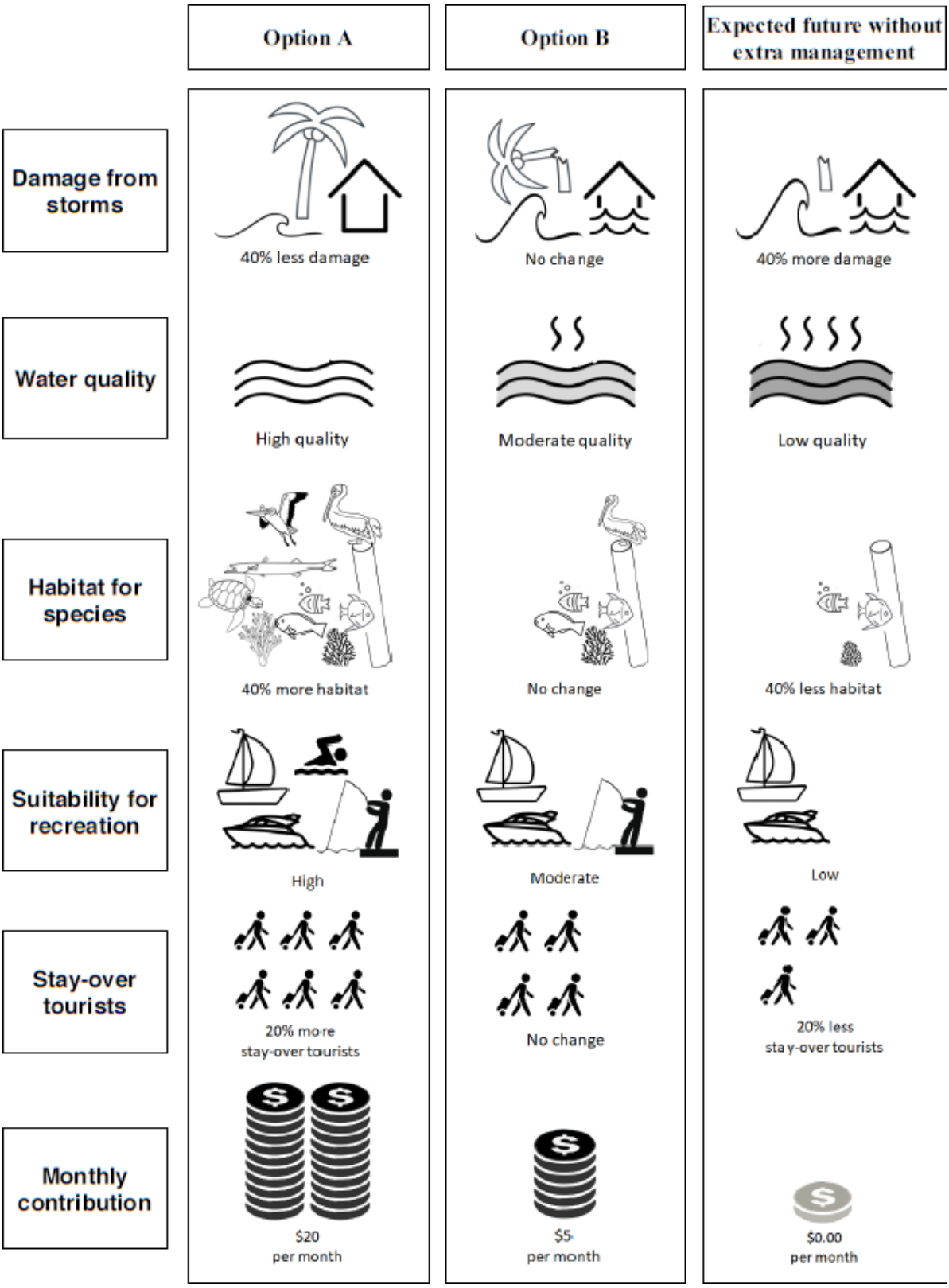

Figure 4.3: Example choice card

After designing the attributes and attribute levels, graphical designs were made by Pieter van Beukering that corresponded to the different attributes and levels. This CE consisted of 4 different versions, each consisting of 6 choice cards. In scenario A and B, environmental management of the Simpson Bay Lagoon was applied, which required a monthly contribution. Option C represented the expected future without extra management, which did not require a monthly contribution. Figure 4.3 shows the example choice card, which was used to explain the choice card to the respondents. In this example, option A shows for all attributes the highest levels, option B shows for all attributes the moderate levels, and option C shows for all attributes the lowest levels. In the actual choice cards, the levels of the attributes of option A and B varied. Option C was consistent throughout all choice cards.

4.1.2 Contingent valuation

The other method that was chosen to measure the study population's value of the ESS provided by the Simpson Bay Lagoon was a CV. CV is a reliable and widely accepted method that measures the value of non-market goods. Some researchers even argue that the CV is the most promising method to determine the WTP for many public goods (Mitchel & Carson, 2013). This method is also very useful when estimating the economic values of ecosystems and ESS. When CV is used for this purpose, it refers to a specific hypothetical scenario and description of environmental services. It asks respondents directly for their maximum WTP for a positive change of an ecosystem. In this research, two questions were asked to the respondents:

- Are you in principle willing to pay for environmental management of the Simpson Bay Lagoon?
- If yes, what is your maximum amount of monthly contribution you are willing to pay for environmental management of the Simpson Bay Lagoon?

The open-endedness of the last question gave the respondents the opportunity to state their monthly maximum WTP for the environmental management of the Simpson Bay Lagoon freely. To overcome non-responses due to the difficulty of stating a maximum amount without any guidelines, a payment card was provided to the respondents (appendix I). This payment card stated some amounts that the respondents could pay. It was made sure respondents were aware that they could also pay any other amount that was not stated on the payment card. Furthermore, the interviewers pointed out that the contribution was monthly and that the respondents needed to take into account their current income level.

4.2 Data collection

The data was collected by means of a household survey on the island of Saint Martin. The survey was conducted from the 22nd of April until the 14th of May. In total, 219 surveys were collected during this time, of which 131 were conducted on the Dutch side of the island and 88 on the French side. The majority of the surveys were conducted on the Dutch side, as more people live on this side on the island. Also, since the researchers were not fluent in the French language, conducting surveys on the French side was challenging. Furthermore, the majority of the surveys were conducted inside the lagoon area, which included the areas of Cole Bay, Simpson Bay and the Lowlands for the Dutch side and Marigot, Les Terres Basses and Sandy Ground for the French side. Moreover, a small sample of surveys was conducted outside the lagoon area on both the Dutch and French side of the island. The number of respondents per area can be found in Table 4.2. The survey was translated to French, to ensure proper understanding of the questions on the French side of the island.

Table 4.2: Number of respondents per area

Island side	Area	Number of respondents
Dutch side	Cole Bay	89
	Simpson Bay	13
	Lowlands	8
	Outside lagoon area	21
French side	Sandy Ground and Les Terres Basses	43
	Marigot	33
	Outside lagoon area	12

4.2.1 Study site and population

Participants of this research were residents of the island of Saint Martin, including both the French and Dutch side of the island. Tourists and short-time visitors of the island were excluded from participating in this research. The minimum age of the participants was set at 18 years, due to ethical considerations. The whole island was selected as the study site, although the main share of the study population was located around the lagoon area. Figure 4.4 shows a map of the island with red dots, which represent the areas were surveys were conducted.

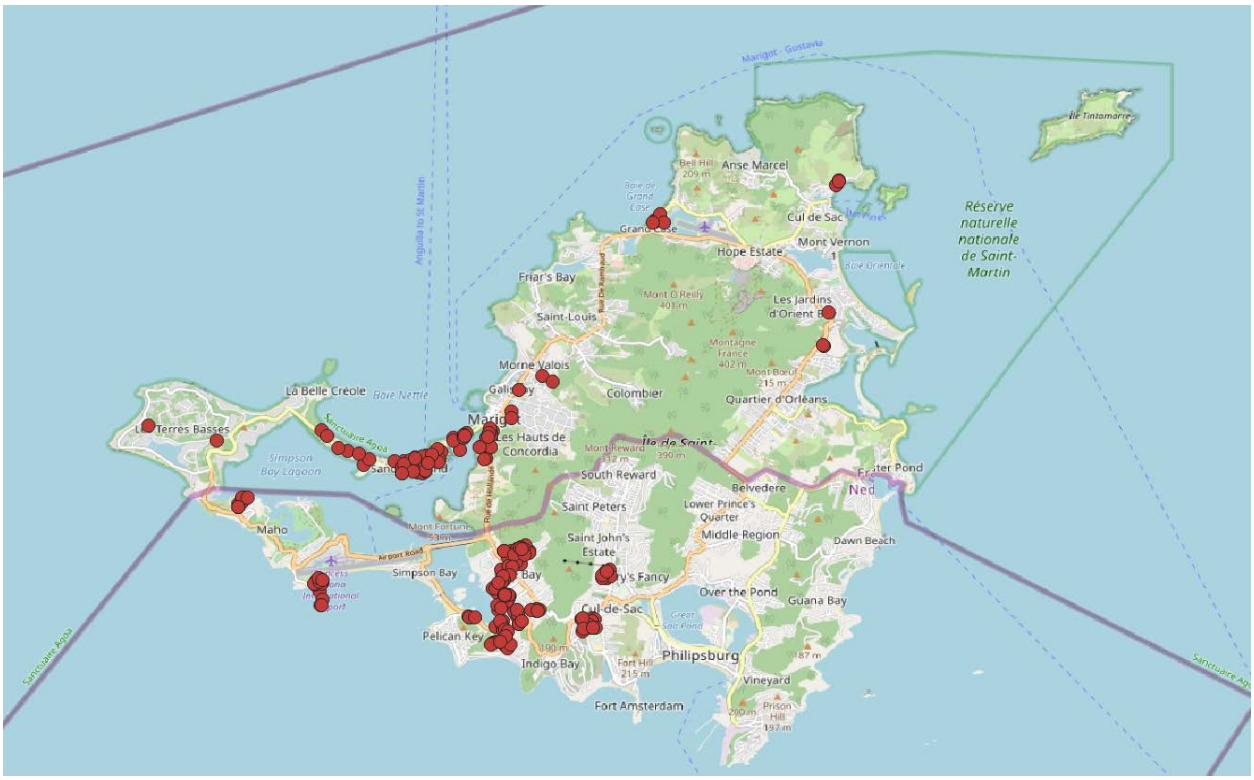

Figure 4.4: Map of Sint Maarten/Saint Martin with red dots representing study areas.

4.2.2 Sampling strategy

This study made use of stratified sampling. Census data on the population of both the Dutch and French side of Saint Martin were used to determine the amount of households that needed to be approached

per neighborhood, corresponding to the percentage of residents that lived in these areas. Table 4.2 provides an overview of the total amount of households that were interviewed per neighborhood. While conducting the survey the interviewers tried to knock on every third door to ensure random sampling. However, due to practical reasons, such as aggressive dogs, inaccessible gates and refusal of participating, convenient sampling was often applied.

4.2.3 Data collection tool

To collect the data, the survey was digitalized and displayed on tablets. Harvest Your Data software was used to do this. This is a type of data collection software that allows researchers to conduct digital surveys off-line. The data could be uploaded when entering a Wi-Fi zone. The software made use of geo-tagging, which allowed researchers to spatially visualize the locations of the surveys. The data was downloaded in SPSS data analysis software.

4.2.4 Interview team

The majority of the surveys were conducted by the researchers themselves (Anna Fralikhina, Sem Duijndam and Anne Molenaar). However, to ensure a representative sample on the French side of the island, including people that did not speak English, three native French speakers were hired to help conduct the surveys on the French side. The interviewers were extensively trained by the researchers. Furthermore, they were provided with a set of documents to ensure their understanding of the survey content and procedure. The interviewers were monitored daily by the researchers to ensure they were conducting the surveys as instructed and would manage to reach their promised target.

4.3 Data analysis

The raw data provided by the Harvest Your Data software was downloaded in SPSS 25.0 data analysis software. Thereafter, the data was manually checked to exclude some errors and missing data. The following section will explain what type of statistical analysis was applied to investigate the research questions of this study.

4.3.1 Representativeness of the population sample

The representativeness of the sample population was investigated by comparing the demographic profile of the sample with the demographic profile of the total population of Saint Martin. As the data from the statistics department of the Dutch government was confidential, a representative of this department performed the statistical tests. The following variables were compared to ensure representativeness of the sample population of the Dutch side: gender, age, country of origin, education level and household income. For the sample of the French part of the island, statistical data was obtained from the internet. Only the representativeness of the variables gender and born on Saint Martin were tested. This was due to the lack applicable data on this side of the island. A chi-square was used to test the statistical representativeness of the population sample. This test assumed the following hypotheses:

H_0: The data is consistent with the specified distribution (i.e. the frequencies are equal)
H_1: The data is not consistent with the specified distribution (i.e. the frequencies are unequal)

The null hypothesis was rejected if the p-value was greater than 0.05, in this case the research sample was representative of the population of Sint Maarten. Furthermore, descriptive statistics were performed to present the population demographics numerically and graphically.

The population sample was to a certain extent representative for the total population of the Dutch and French side of the island. The variable gender was representative for the total population of the French side of the island. The variables gender and age were representative for the total population of the Dutch side of the island. Because not all demographic variables were representative for the total population, one must be careful with extrapolating the results. Also, in further research, a larger population sample may increase the representativeness of the sample.

4.3.2 Population perspective on the environmental condition of the Simpson Bay Lagoon

Section 2 (recreational activities on the lagoon), 3 (environmental condition of the lagoon) and 4 (management activities) of the survey were investigated by means of descriptive statistics. This provided an overview of how the local population uses the lagoon and what their perspective is on the poor environmental condition and possible management options to restore it.

4.3.3 Choice experiment

The CE was analyzed by the research team using a random parameter logit model with 1000 random draws to analyze the WTP for the different attributes. The random parameter logit model generates individual WTP estimates for each respondent in the sample. So for each respondent it was clear how much he or she was WTP for each attribute. This was very useful for the analysis of the socio-cultural background in relation to the different WTP values, because these individual WTP values allowed to do statistical tests such as one-way ANOVA, Spearman correlation and regression analysis. Furthermore, only respondents that chose at least two times for option A or B were included in the random parameter logit model, which provides more reliable individual estimates.

4.3.4 Analysis of socio-cultural context

In the analysis of the socio-cultural context of Saint Martin, the relationships between demographic variables and the appreciation of ESS was investigated. Also, participation in certain recreational or environmental activities were related to different demographic variables and the different WTP values. For recreational activities and environmental behavior, a total score was created that added up the score (on 5-likert scale) of all activities respondents were asked about. The variables gender, born on Saint Martin, education level and household income were recoded into a dummy variable. For education level, no education, primary school, high school and vocational school were recoded into 0; University of applied sciences, university bachelor and university master were recoded into 1. For household income, all income categories up to 1,599 US dollars per month were coded as 0, all income levels above were recoded as 1.

To test the relationships between the demographic variables, the total scores for recreational activities and environmental behavior, the statement questions for well-being, the different values of nature and the different WTP values, one-way ANOVA and Spearman Correlation tests were used. Spearman correlation tests were perceived to be the most appropriate statistical method to test for correlation between two continuous variables, as this test does not require a normal distribution of the sample. As the data used in this research was obtained through a survey with a limited number of responses, many variables were not normally distributed. One-way ANOVA tests were used to test the relationships between a continuous variable (such as the different WTP values or the total scores for environmental behavior and recreation) and a dichotomous variable (such as gender, born on Saint Martin, education and household income). Furthermore, a regression analysis was done to test the relationship amongst the different demographic variables and the CV WTP.

The individual versus collective attitude of the respondents was investigated in two ways. First of all, the survey included two statement questions related to the benefits of the lagoon and respondent's own well-being and the well-being of others. The relationship between these two questions and the different WTP values were investigated by a Spearman Correlation test. Secondly, it was tested whether respondents that lived inside the lagoon area were more WTP than respondents that lived outside of the lagoon area. This relationship was tested with one-way ANOVA tests.

4.4 Strengths and limitations

The main data collection method for this research was a household survey. The survey was quite extensive and took on average 32 minutes to finish. Though some respondents complained about the length of the survey, most respondents were fine with it. When a similar study would be conducted in the future the survey could be around the same length. Furthermore, consulting local environmental experts to validate the CE resulted in a reduction of attributes for the final CE, as some attributes were not very applicable to the local context. Also the pre-test that was conducted thereafter resulted in some useful improvements in the wording of certain questions which improved the understandability of the survey. The use of tablets for data collection was very useful. Conducting the survey on a tablet was easier and more fun for most respondents. Some respondents that did not know how to use a tablet could be assisted by one of the interviewers. Moreover, the tablet saved the time of when the interview started and ended, which allowed the researchers to check whether the research assistants were properly conducting the interviews. The interview was available in two languages, namely English and French. Saint Martin has a large Spanish speaking population, which was excluded from participation in this research. For future research it might be interesting to translate the survey into Spanish as well.

A weakness of this study is that not all demographic variables were representative for the total population of the island. This may be due to the size of the sample. The WTP values that were found in this study were quite high compared to similar studies done on other Caribbean islands. The values might be biased because people that did not care about the environment might also not have been willing to participate in the survey. Furthermore, for the participation in environmental activities, some questions might have been a bit open for interpretation. Different people might have different perceptions on the terms very often, often, sometimes or rarely. Furthermore, the attribute water quality might have a relationship with some of the other attributes of the CE as well. It can be argued that by improving water quality, the level of the some other attributes, such as habitat for species and suitability for recreation might improve to some extent as well.

5. Results

This chapter will describe the results that were obtained by analyzing the data of the household survey. First, the population sample will be described and the representativeness of this sample will be discussed. Thereafter, the use of the lagoon, the perception on the environmental problem and perception on possible solutions to the problem will be described by means of descriptive statistics. Thereafter, the analysis of the socio-cultural background of the study population in relation to the economic valuation will be described.

5.1 Description of the population sample and representativeness

5.1.1 Gender

The gender distribution of the population sample was compared to the statistical data of the Dutch and French statistics department respectively. The population of Sint Maarten and Sint Martin both have a small overrepresentation of females (53% and 52% respectively). In the population sample, there was a slight overrepresentation of males (52% and 53% respectively). Still, the chi-square test shows that the sample population is representative for the total population of the Dutch side (chi-square = 1.357, p = 0.244) and the French side (chi-square = 1.318, p = 0.251).

5.1.2 Age

Figure 5.1 shows the age distribution of both the Dutch and French sample population. Next to the bars with the Dutch sample population the data from the department of statistics of the Dutch side can be found. The distribution pattern for age is quite similar to the data from the statistics department. The chi-square test shows that the Dutch sample population is representative for the total population of the Dutch side (chi-square = 9.29, p = 0.158).

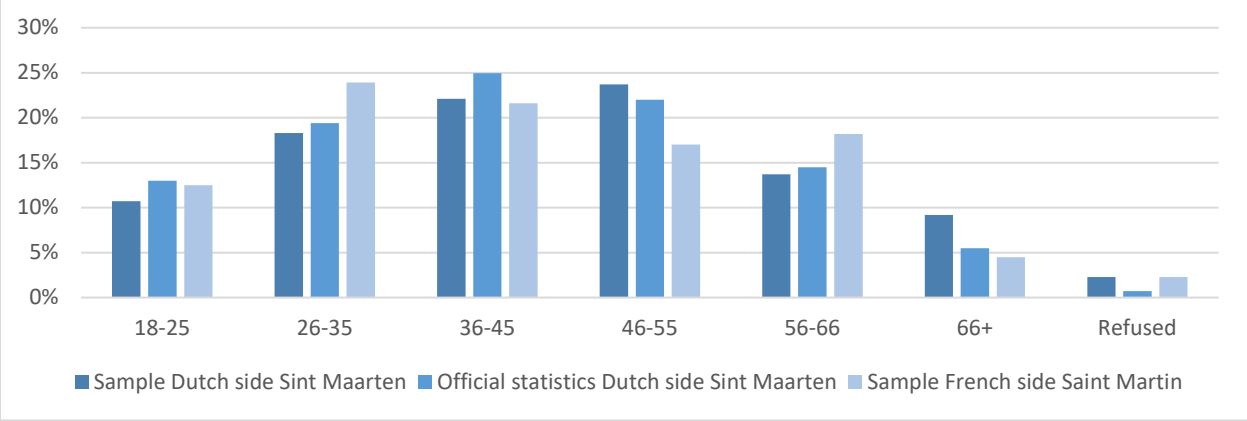

Figure 5.1: Age distribution of the population sample

5.1.3 Country of origin

For the Dutch side, 34% of the sample population was born on the island, compared to 23% according to the data of the statistics department. The chi-square test showed that the sample population was not statistically representative for the total population of the Dutch side (chi-square = 10.514, p = 0.001). For the French side, in the sample population 27% was born on the island, compared to 36% that was recorded by census data (Insee Dossier Guadeloupe, Antilles-Guyane, 2016), the chi-square test shows that the

population sample is not representative for the total population of the French side, although the p value is very close to 0.05 (chi-square = 3.915, p = 0.048)

Respondents that were not born on the island were asked about their country of origin. Statistical data from the French side of the island was lacking, therefore only the representativeness of the Dutch sample population was tested. The chi-square test showed that the sample population of the Dutch side is not statistically representative for the total population (chi-square = 69.69, p = 0.000). Respondents that were not born on the island lived on an average of since 16.14 years on the island (sd. = 14).

5.1.4 Level of education

Figure 5.2 shows the distribution of the level of education for both the Dutch and the French sample population. Also the data from the statistics department of the Dutch side is presented. As can be seen in the figure, some levels of education deviate quite a bit from the data from the statistics departments. The chi-square tests shows that the Dutch sample population is not representative for the total population of in terms of education level (chi-square = 505.15, p = 0.000)

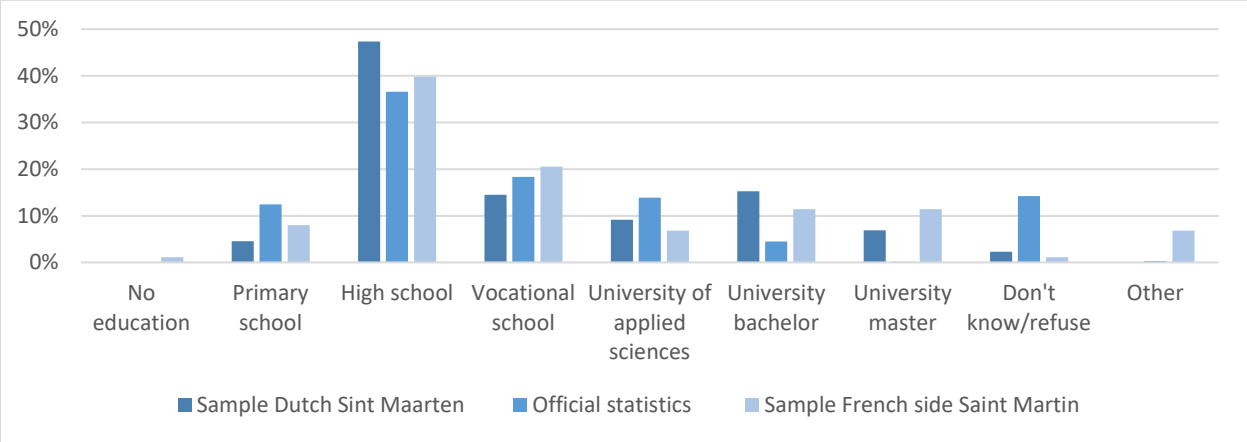

Figure 5.2: Distribution of education level of the population sample

5.1.5 Household income

The distribution of household income for both the Dutch and French side of the island can be found in Figure 5.3. Due to a lack of data from both the statistics departments of the Dutch and the French side, this variable could not be tested for representativeness.

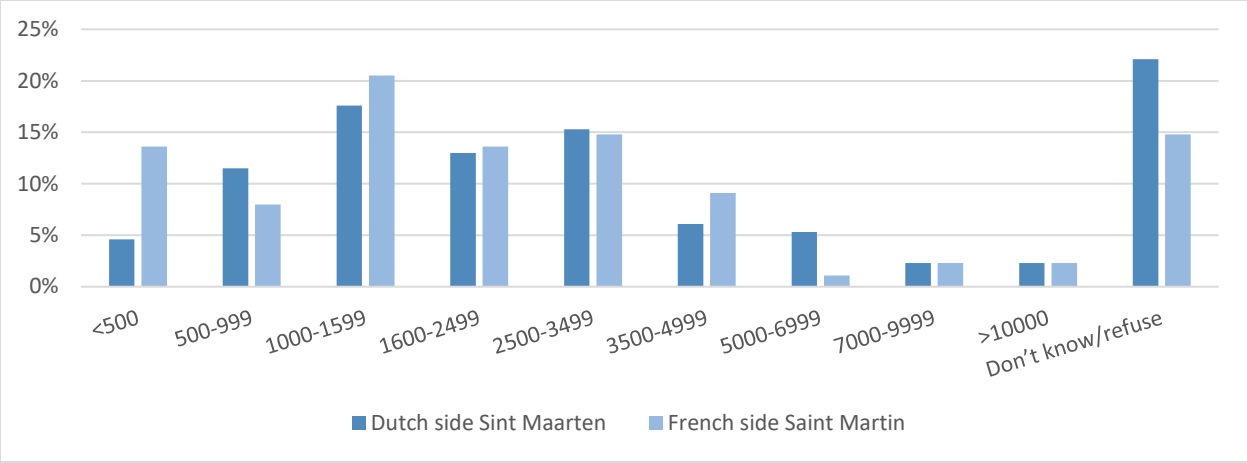

Figure 5.3: Distribution of household income of the population sample

5.2 Perception on the environmental problem

5.2.1 Changes in lagoon's environmental condition

Of all respondents, 78% indicated that they noticed changes in the lagoon's environmental condition over the past 10 years or since they arrived on Saint Martin. The respondents were offered some examples of specific changes in environmental condition that they might have noticed, including trash and plastic pollution in the water or on the shores, dirty water, bad smell coming from the lagoon and less fish in the water. Respondents were able to indicate more than one of these changes. The specific changes that were noticed by the respondents are presented in Figure 5.4. The most often indicated change was trash and plastic pollution, followed by dirty water. The least indicated change was less fish in the water. Respondents could also indicate any other type of change they might have noticed. These indicated changes included: the increase of the amount of the shipwrecks in the lagoon, rapid development and construction around the lagoon, algae blooms, destruction of mangroves, and change in color of the water.

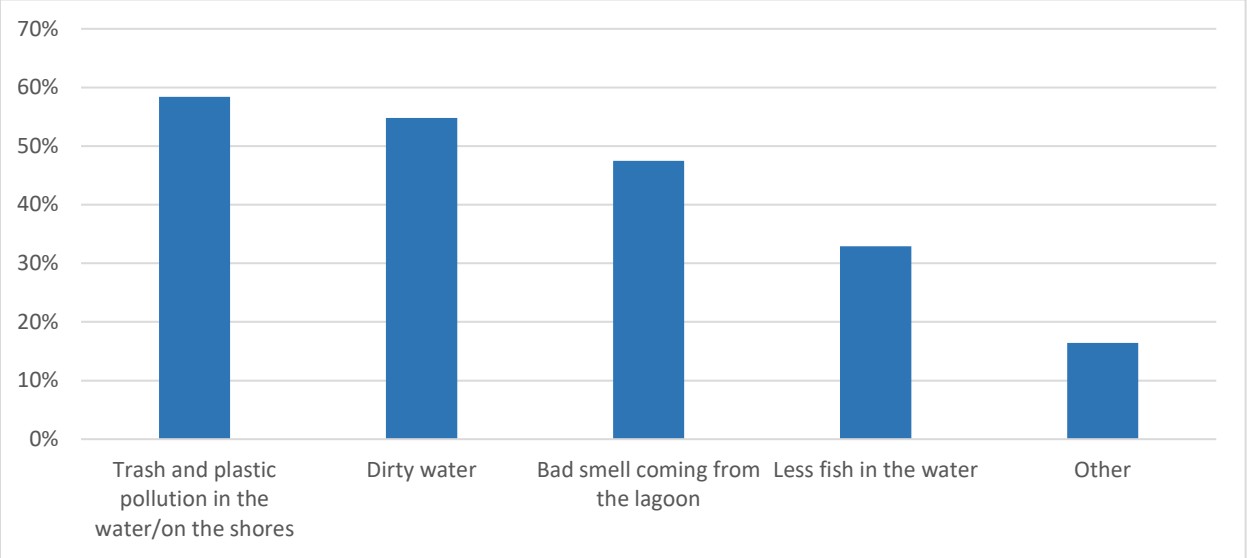

Figure 5.4: Specific changes in the environmental condition of the Simpson Bay Lagoon over the last 10 years or since arrival on Saint Martin

5.2.2 Reasons for lagoon's poor environmental condition

Respondents were asked to indicate how important they found some possible causes of the poor environmental condition of the Simpson Bay Lagoon. These reasons included sewage pollution, garbage pollution, shipwrecks, mangrove destruction, construction and development and invasive species. The respondents were asked to indicate their importance on a five-Likert scale, ranging from not important to very important. The importance the respondents assigned to the respective reasons are presented in Figure 5.5. It can be concluded that sewage pollution was perceived to be the most important reason for the poor environmental condition of the Simpson Bay Lagoon according to the respondents, followed by garbage pollution. The reason perceived to be least important was invasive species, although still more than 50% of the respondents indicated this reason was at least somewhat important.

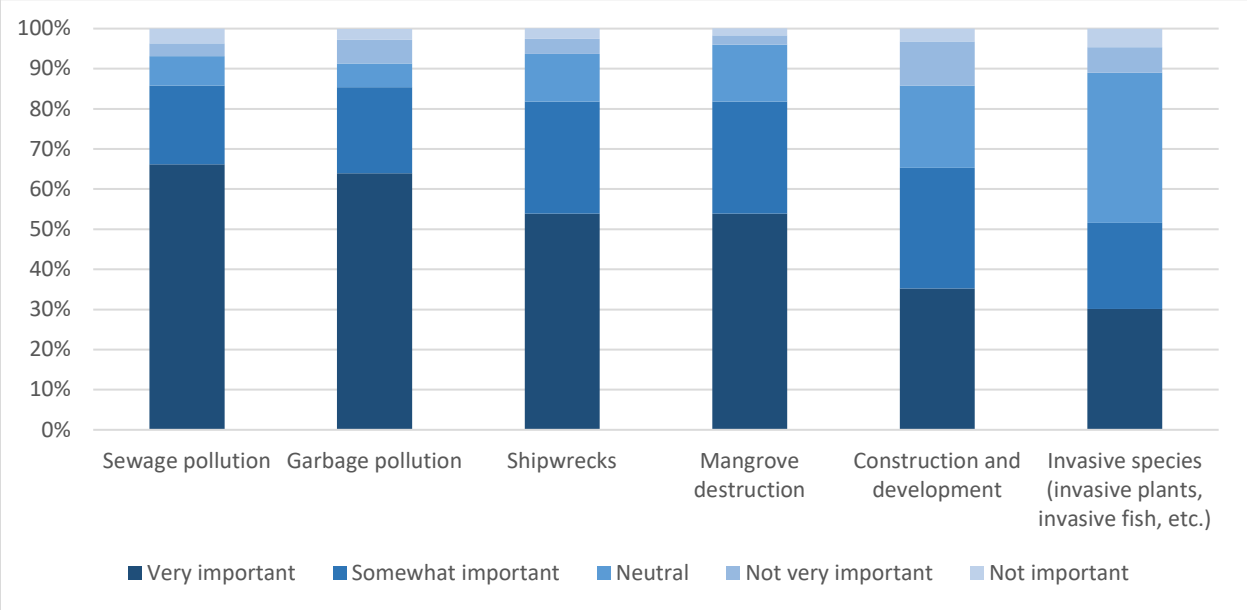

Figure 5.5: Respondent's perceived importance of different reasons for the poor environmental condition of the Simpson Bay Lagoon.

5.2.3 Actor most responsible for poor environmental condition of the lagoon

The respondents were asked about who they thought was most responsible for the poor environmental condition of the Simpson Bay Lagoon. They were offered five options to choose from, namely: tourists, government, businesses, residents and other. The respective percentages of the chosen answers are presented in Figure 5.6. It is interesting to see that the vast majority of the respondents perceived the government to be the most responsible actor of the poor environmental condition of the Simpson Bay lagoon, followed by the businesses. Of all respondents, 6% chose the 'other' option, of which the majority indicated that everyone was responsible, not just one of these actors.

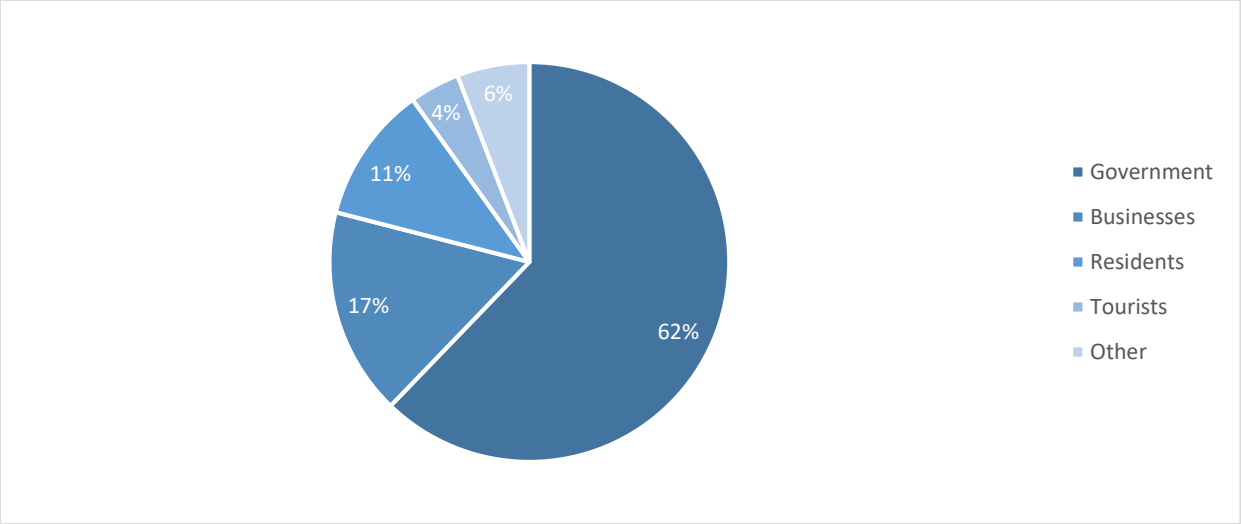

Figure 5.6: Actor most responsible for the poor environmental condition of the Simpson Bay Lagoon

5.3 Perceived solution to the problem

5.3.1 Management options

Six different management options that would contribute to the improvement of the environmental condition of the Simpson Bay Lagoon were presented to the respondents in order to investigate the level of support they assigned to them. Respondents were asked to indicate for each management option to which extent they were in favor of implementing them, on a 5-likert scale. The results of this question are presented in Figure 5.7. It is interesting to note that all provided management options were highly appreciated by the respondents. For all of them, more than 60% of the respondents indicated that they were in favor or highly in favor of implementing them. The environmental awareness raising was supported the most by the respondents, followed by enforcing environmental regulations and removing shipwrecks. The management option with the lowest level of support was restricting development.

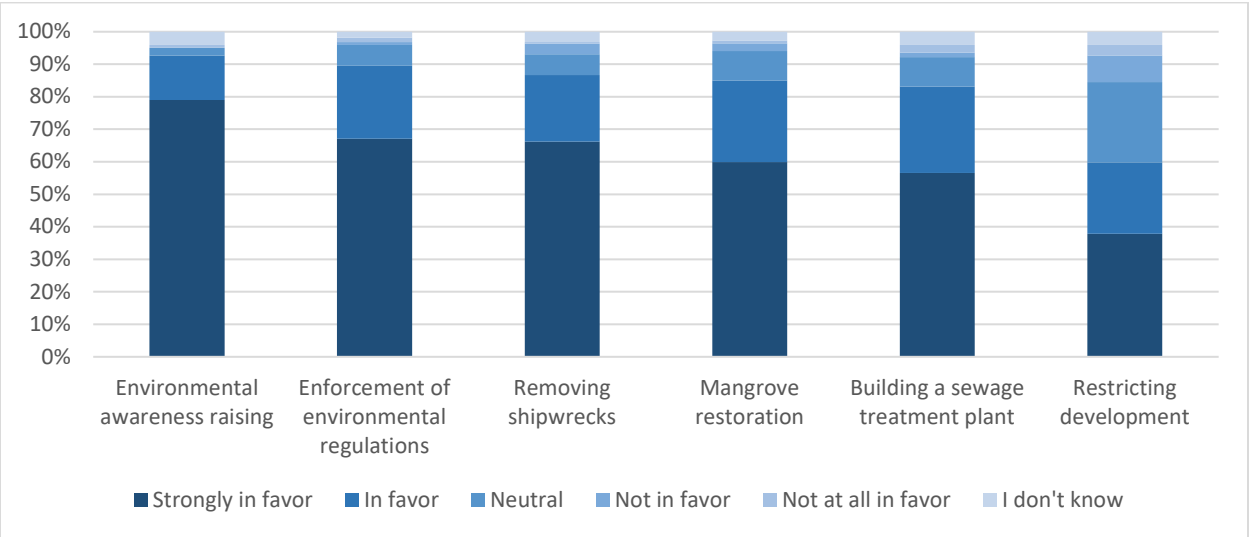

Figure 5.7: Relative support for different management options

5.3.2 Organization that should manage the funds

Participants were asked which organization they thought should manage the funds for environmental management of the lagoon. The option local environmental organization gets the most support from the respondents. The results of this question can be found in 5.8.

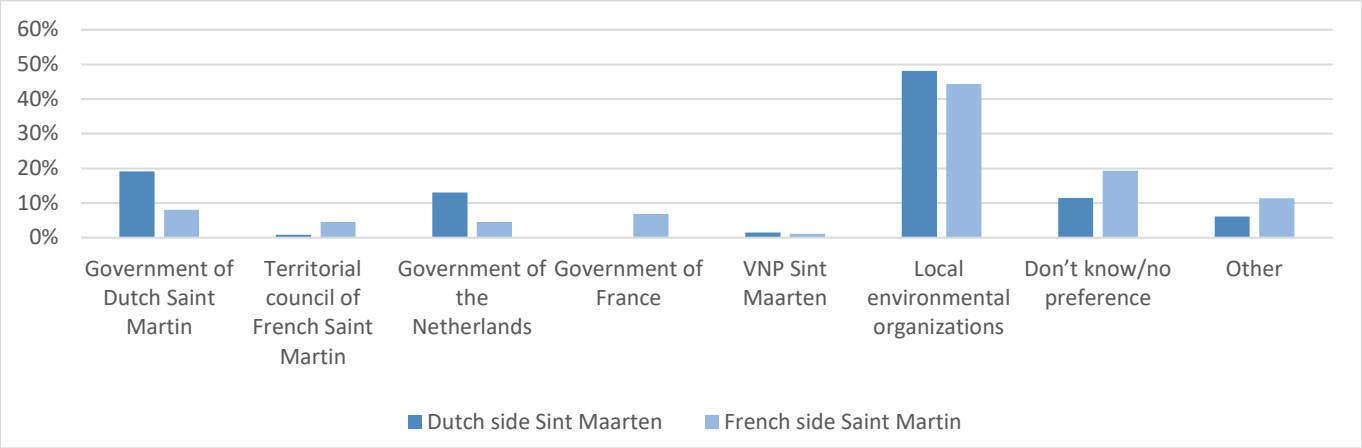

Figure 5.8: Organization that should manage the funds for environmental management of the Simpson Bay lagoon

5.4 Environmental awareness and behavior

Throughout the survey, respondents were asked about their environmental awareness and how often they participated in certain environmental behavior activities. Figure 5.9 presents the responses to the statement: "I consider myself environmentally aware". On average the respondents indicated a mean score of 4.15 on environmental awareness. It was also tested whether this self-reported environmental awareness was related to the different demographic variables. One-way ANOVA and Spearman Correlation tests were performed to test these relationships. The self-reported environmental awareness score was significantly related to education ($p = 0.000$), household income ($p = 0.001$) and origin ($p = 0.002$). Additional descriptive statistics showed that respondents with a higher level of education or a higher level of income considered themselves more environmentally aware. People that originated from North America considered themselves most environmentally aware, followed by French mainland, born on the island, Netherlands mainland, elsewhere in the Caribbean and elsewhere in Latin America. Also, a Spearman Correlation test showed that age was significantly correlated to environmental awareness. This means that younger people considered themselves more environmentally aware. The results of these statistical tests can be found in Table 5.1.

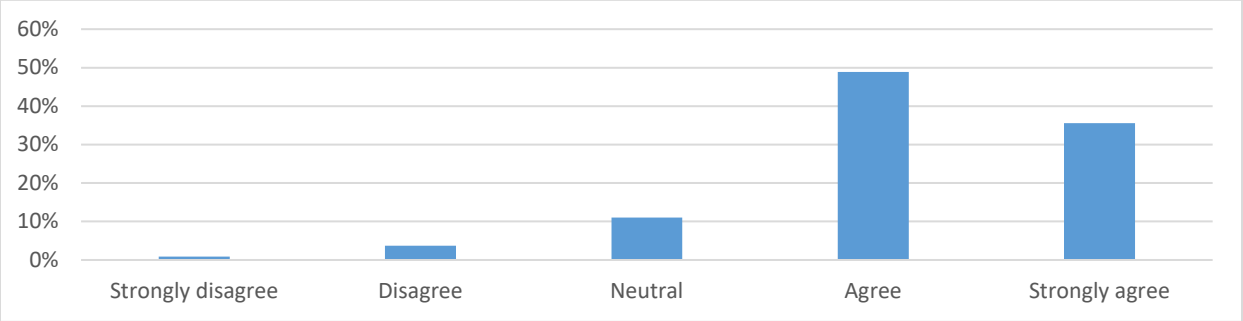

Figure 5.9: Distribution of self-reported environmental awareness of total population sample

Table 5.1: Relationships between education level, household income, origin, age and self-reported environmental awareness

	Correlation Coefficient	**P-value**
Education level	18.085	0.000***
Household income	12.245	0.001**
Origin	3.459	0.002**
Age	0.255	0.000***

Furthermore, respondents were asked to indicate on a 5 Likert scale (never, once a year, once a month, once a week and more than once a week) how often they participated in certain environmental behavior activities over the last year. The results of these questions can be found in Figure 5.10.

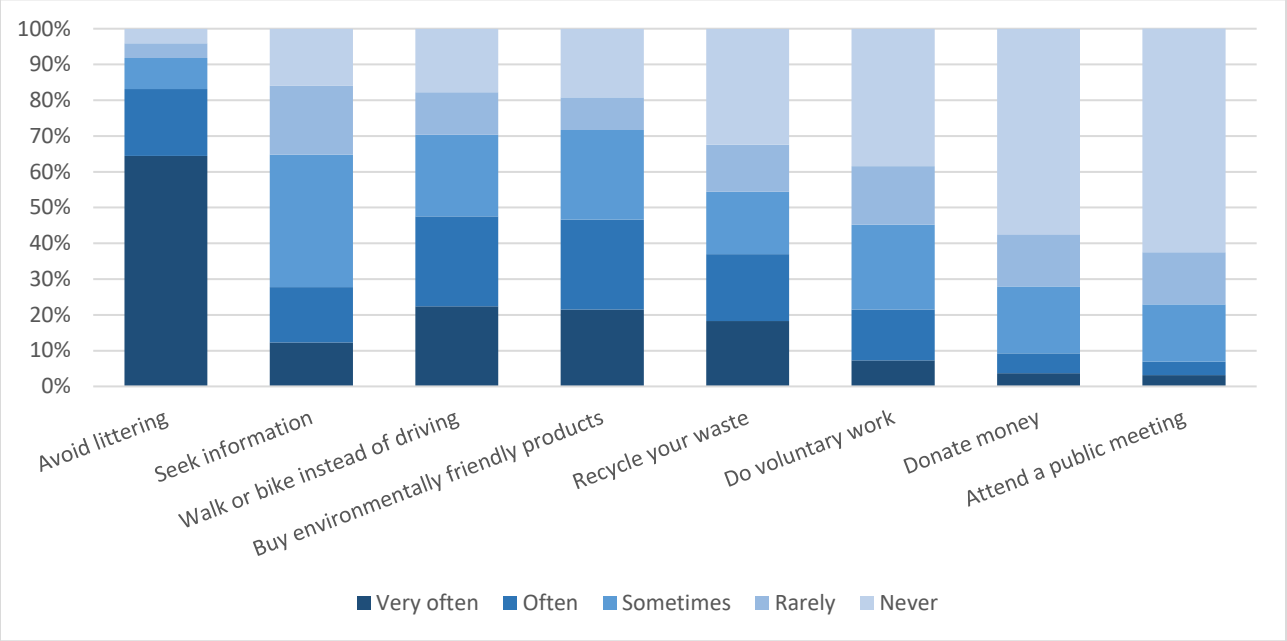

Figure 5.10: Participation rate in activities related to the environment

Moreover, it was tested whether the demographic variables were related to the total score for environmental behavior. The one-way ANOVA test with additional descriptive statistics showed that respondents with a higher level of education or a higher level of household income had a significantly higher total score for environmental behavior. Origin was also significantly related to environmental behavior. Respondents from North America had the highest score, followed by French mainland, Saint Martin, Netherlands mainland, elsewhere in the Caribbean and elsewhere in Latin America. Spearman Correlation tests showed that the amount of years lived on the island had a significant negative relationship with the total score for environmental behavior. Lastly, self-reported environmental awareness and the total score for environmental behavior were also significantly related ($p = 0.000$). The results of these statistical tests are displayed in Table 5.2.

Table 5.2: Relationships between education level, household income, years lived on the island and the total score for environmental behavior.

	Correlation Coefficient	P-value
Education level	18.085	0.000***
Household income	12.245	0.001**
Origin	3.459	0.002**
Years lived on the island	-0.241	0.004**
Environmental awareness	0.296	0.000***

5.5 Recreational activities of the Simpson Bay Lagoon

In what way the Simpson Bay Lagoon is used by the residents of Saint Martin was investigated by asking how often the respondents participated in different recreational activities in the last year. These recreational activities included: spending time near the lagoon; walking, jogging or cycling around the lagoon; bird- and wildlife watching; boating or sailing; swimming; and fishing. Figure 5.11 shows these specific recreational activities and how frequently the respondents participated in them.

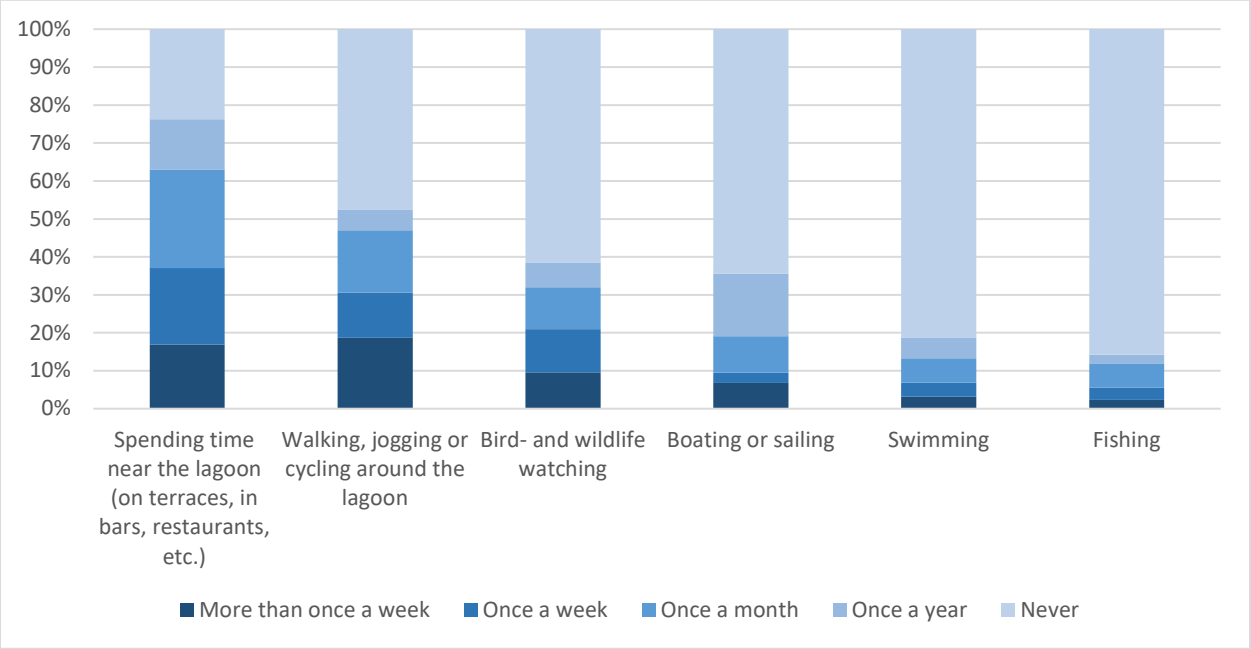

Figure 5.11: Frequency of recreational activities on the Simpson Bay Lagoon

One-way ANOVA tests showed that gender (p = 0.004) household income (p = 0.017) and origin (0.028) were significantly related to the total score for recreational activities. Additional descriptive statistics showed that men or respondents with a higher household income had a significantly higher total score for recreational activities. Respondents from North America had the highest score for recreation, followed by French mainland, elsewhere in Latin America, Saint Martin, elsewhere in the Caribbean and Netherlands mainland. Furthermore, Spearman Correlation tests showed that the amount of years lived on the island was negatively correlated with the total score for recreational activities. The results of these statistical tests can be found in Table 5.3. Furthermore, the total score for recreation and the total score

for environmental behavior are also significantly related (p = 0.000). Meaning that respondents that were performing a lot of recreation on the lagoon also had a better environmental behavior.

Table 5.3: *Relationships between gender, household income and recreational activities total score*

	Correlation Coefficient	**P-value**
Gender	8.673	0.004**
Household income	5.812	0.017*
Origin	2.306	0.028*
Years lived on the island	-0.178	0.034*

5.6 The intrinsic value of nature

The respondents were asked whether they thought nature should be protected from human pollution. 99.5% of the respondents answered yes to this question. Thereafter the respondents were asked why they thought nature should be protected from human pollution. They were able to choose between three answers: for its own sake, it has an important value of its own (intrinsic value, 52% of all responses); so humans can benefit from it (instrumental value, 32% of all responses); and because of its cultural and historical value (relational value, 14% of all responses).

Dummy variables were created for each answer and it was tested with a one-way ANOVA test whether these variables were significantly related to the WTP values of the CV and the WTP for the different attributes of the CE. No significant relationships were found. Furthermore, it was tested whether the demographic variables and the total score for environmental behavior had a significant relationship with the different values of nature. Again, one-way ANOVA tests were performed which showed that gender had a significant relationship with intrinsic value (p = 0.009) and instrumental value (0.025). Additional descriptive statistics showed that on average women had a more intrinsic value of nature and men a more instrumental value.

5.7 Well-being

The respondents were asked about their level of agreement (strongly disagree, disagree, neutral, agree or strongly agree) with different statements that measured what impact the ecosystem of the Simpson Bay Lagoon had on the well-being of the respondents. These statements included:

- The benefits provided by the lagoon are important for my own well-being
- The pollution of the lagoon has a negative effect on my health
- The area around the lagoon is an important place to meet other people for social interaction
- The benefits provided by the lagoon are important for my income
- The cultural and historical aspect of the lagoon is import to me

The results of these statement questions are presented in the Figure below (Figure 5.12)

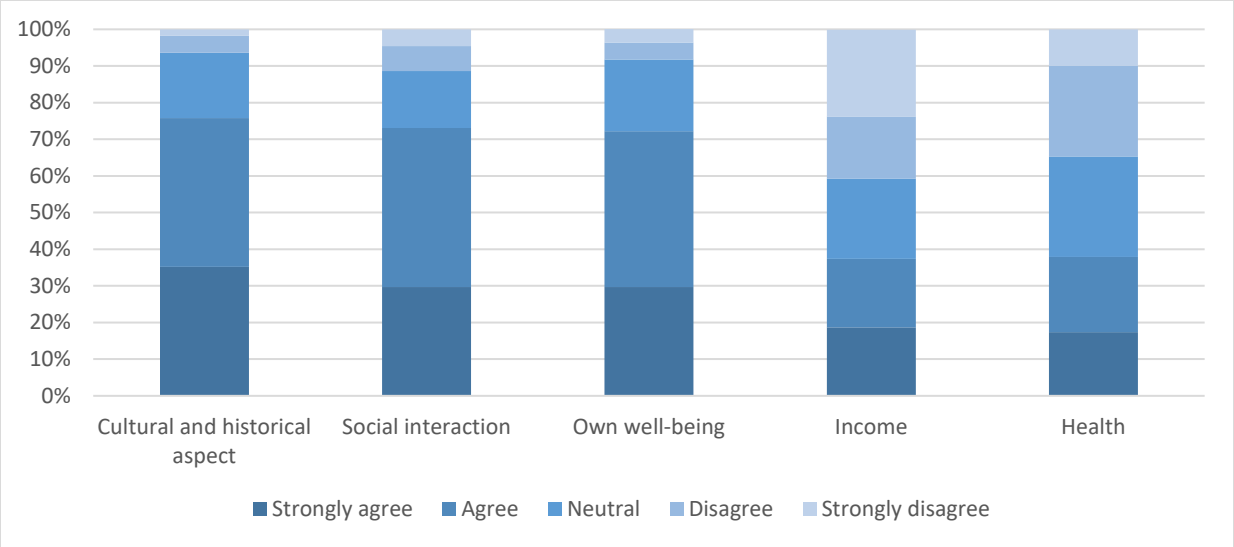

Figure 5.12: Responses to different statement questions related to well-being and the Simpson Bay Lagoon

5.8 Individual versus collective attitude

The individual versus collective attitude of the respondents was investigated in two ways. First of all, the survey included two statement questions (strongly disagree, disagree, neutral, agree and strongly agree) about general well-being in relation to the lagoon. Namely: The benefits provided by the lagoon are important for my own well-being; and the benefits provided by the lagoon are important for the well-being of other people on Saint Martin. The relationship between these two questions and the different WTP values was investigated by a Spearman Correlation test. Respondents that indicated that the benefits provided by the lagoon were important for their own well-being were significantly more WTP ($p = 0.005$). However, no significant relationship was found between the importance of the benefits of the lagoon for the well-being of others and the different WTP values. For both questions, no relationships were found with the WTP for the different attributes of the CE.

Secondly, it was tested whether respondents that lived inside the lagoon area were more WTP for environmental management than respondents that lived outside of the lagoon area. A dummy variable was created, that had the value 1 for respondents that lived inside the lagoon area and value 2 for respondents that lived outside of the lagoon area. A one-way ANOVA test was performed to see whether the mean WTP of these two categories significantly differed, which was not the case.

5.9 Choice Experiment

Table 5.4 shows the results of the analysis of the CE. 14% of the respondents chose for the opt-out option in one or more of the choice cards. For the following attributes the respondents were significantly WTP: damage from storms, water quality moderate, water quality high and habitat for species. For suitability for recreation and the amount of stay-over tourists, the WTP was insignificant. Only the average WTP values for the significant attributes are presented in the Table. The WTP values are calculated based on averages from individual parameter estimates. The WTP value for the attribute damage from storms should be interpreted as follows: on average the respondents were WTP 0.2799 US dollars per household

per month for each percentage reduction in damage. For the attribute habitat for species the WTP value can be interpreted in a similar way: on average the respondents were WTP $0.3275 per household per month for each percentage increase in habitat for species. For moderate water quality, respondents were WTP $16.41 per household per month, for high water quality $25.66 per household per month.

To derive the total WTP from the CE, it will be assumed that the respondents will pay for the highest level of each attribute. For the attribute damage from storms this means a 40% decrease in the damage caused by storms, the WTP for this decrease would be $11.20 per household per month (40*0.2799). For the attribute habitat for "species" this means a 40% increase in the habitat for species, the WTP for this increase would be $13.10 per household per month (0.3275*40). The average WTP amounts for suitability for recreation and the amount of stay-over tourists were obtained from descriptive statistics in SPSS. This resulted in a maximum WTP of $3.36 for tourists (0.1681*20) and an average WTP for recreation of -$1.68. The total WTP can be calculated by adding up the maximum WTP values of all attributes, which results in a WTP of $51.64 per household per month (11.20+13.10+25.66+3.36-1.68). The total WTP could also be calculated by adding up only the highest levels of the significant attributes, which would resulted in a total WTP of $49.96 per household per month.

The average CE WTP per household on Saint Martin was high compared to studies done on the other islands. On average, respondents were WTP $51.64 per household per month, compared to $13.38 on Aruba, $13.00 on Saba, $13.80 on St. Eustatius and $50-70 on Bonaire. However, it should be noted that our study was focused on the environmental management of one single ecosystem. The studies on Aruba, Bonaire, Saba and St. Eustatius focused on environmental management of the marine and terrestrial environment of the whole island.

Table 5.4: Results of the random parameter logit model and WTP estimates for choice attribute levels.

Attribute	**Coefficient**	**Standard Error**	**Significance**	**WTP (calculated based on averages from individual parameter estimates)**
Damage from storms (%)	0.0405	0.0054	0***	0.2799
Water quality moderate	2.3451	0.3297	0***	16.4109
Water quality high	3.7271	0.3593	0***	25.6634
Habitat for species (%)	0.0471	0.006	0***	0.3275
Suitability for recreation	-0.3161	0.1283	0.0138	-
Stay-over tourists (%)	0.0192	0.0121	0.1134	-
Payment vehicle	-0.1501	0.0232	0	-
Number of observations: 1263 *Pseudo R-squared adjusted: 0.3462*				

5.9.1 Relationships between socio-cultural background and CE WTP values

Level of education was significantly related to all four attributes of the CE that the respondents significantly attached value to; damage from storms (p = 0.006), moderate water quality (p = 0.004), high water quality (p = 0.002) and habitat for species (p = 0.001). The results of these tests are displayed in Table 5.5. Additional descriptive statistics pointed out that for all these attributes meant that respondents with a higher level of education were significantly more WTP. Also, the attribute high water quality was significantly related to household income (p = 0.008). Additional descriptive statistics showed that respondents with a higher income were significantly more WTP for the attribute high water quality. One-way ANOVA tests showed that level of education and origin were significantly related (p = 0.000) People originating from Netherlands mainland had the highest level of education, followed by North America, French mainland, Saint Martin, elsewhere in the Caribbean and elsewhere in Latin America.

The attribute high water quality was valued the most compared to the other attributes of the CE. It was tested whether there was a significant relationship between the WTP for high water quality and whether the respondents thought the polluted lagoon had an effect on their health. No significant relationship was found.

Table 5.5: Relationships between education level and different WTP values

	Correlation Coefficient	**P-value**
WTP damage from storms	7.811	0.006**
WTP moderate water quality	8.598	0.004**
WTP high water quality	9.484	0.002**
WTP habitat for species	11.540	0.001**

5.10 Contingent Valuation

The survey also included a contingent valuation question to see if and how much the respondents were willing to pay for the environmental management of the Simpson Bay Lagoon. Seventy seven percent of the respondents were in principle willing to pay for the environmental management of the Simpson Bay Lagoon. This is high compared to other studies that have been done on Caribbean islands. In Aruba 63% of the respondents were WTP for environmental management, compared to 50% on St. Eustatius, 60% on Saba and 64% on Bonaire. The respondents that were willing to pay for the environmental management of the Simpson Bay Lagoon were asked to indicate how much they would be willing to pay per household per month. The mean willingness to pay was 13.76 dollars per household per month. The amounts ranged from 2 dollar to 125 dollar per household per month.

An estimation about the total WTP for environmental management of the Simpson Bay Lagoon can be made by extrapolating the results of WTP value of the CV question. In total, there are 41,442 households on the island (Dutch side: 14,021; French side: 27,421). According to the results, 31,786 households are willing to pay (41,442*0.767). Which results in a total WTP of $43,470.91 that could be used for environmental management of the Simpson Bay Lagoon. However, this extrapolation should be interpreted with care. As this study focused on valuing the ESS of one ecosystem, it is likely that people that do not come into contact with it are less WTP. In addition, the main population sample of this study lived in the area around the lagoon. Only a small part of the sample included people outside of the lagoon area. Therefore, it is uncertain whether this estimation of the total WTP value is adequate.

To increase the validity of this question, the respondents were asked about their certainty of the choice they just made (the amount of money they were willing to pay). The overall certainty of the respondents was very high, with a mean of 4.21 (out of 5).

7.10.1 Relationships between socio-cultural background and CV WTP

The relationship between the following demographic variables and the WTP of the CV were investigated: gender, born on Saint Martin, age, education level and household income. Also, the total scores of recreational activities, environmental behavior and the different statement questions for well-being were related to the CV WTP.

One-way ANOVA tests were performed to see whether the mean of the two categories in the variables age, gender, born on Saint Martin, education level and household income significantly differed from each other in their WTP. Additional descriptive statistics were performed to see which of the categories of the significant variables were more WTP. Spearman Correlation tests were performed to investigate whether the variables age, years on Saint Martin, the total scores for recreational activities and environmental behavior, environmental awareness and the statement questions for well-being were significantly related to the WTP values of the CV question and for the different attributes of the CE. Table 5.6 shows the results of these respective tests. The following variables were significantly related to the WTP value of the CV question: gender ($p = 0.008$), education level ($p = 0.009$), household income ($p = 0.001$), environmental awareness ($p = 0.039$), total score for environmental behavior ($p = 0.001$), total score for recreational activities ($p = 0.006$), own-well-being ($p = 0.005$), culture and history ($p = 0.000$), income ($p = 0.035$) and social interaction ($p = 0.025$).

Additional descriptive statistics showed that women were significantly more WTP than men. Also, respondents with a higher education level or a higher household income were significantly more WTP. Furthermore, respondents with a higher total score for environmental behavior or recreational activities were more WTP for environmental management. Also respondents with a higher self-reported environmental awareness were more WTP. The significance of the different statement questions of well-being indicated that respondents that thought the benefits provided by the lagoon were important for their well-being were significantly more WTP. The same for respondents that thought the cultural and historical value of the lagoon was important to them, respondents that thought the lagoon was an important place to meet other people for social interaction and respondents that thought the benefits provided by the lagoon were important for their income.

Table 5.6: Relationships between demographic variables, total score for environmental behavior and recreational activities, own well-being, culture and history, income, social interaction and WTP of CV

	Correlation coefficient	**P-value**
Gender	7.169	0.008**
Education level	7.048	0.009**
Household income	11.038	0.001**
Environmental awareness	0.139	0.039*
Total score for environmental behavior	0.217	0.001**
Total score for recreational activities	0.185	0.006**

Own well-being	0.190	0.005**
Culture and history	0.255	0.000***
Income	0.143	0.035*
Social interaction	0.151	0.025*

Furthermore, a multiple regression analysis was performed to test the relationships between the demographic variables and the CV WTP. A significant relationship was found with household income (p = 0.021). The results of this test can be found in Table 5.7.

Table 5.7: Multiple regression of CV WTP and household income, gender, island side, age, education and born on the island

	Beta coefficient	**Std. Error**	**P-value**
Constant	9.807	4.557	0.033
Household income	6.996	2.996	0.021*
Gender	-5.326	2,730	0.053
Island side	-3.070	2.722	0.261
Age	1.135	1.010	0.263
Education level	2.711	3.126	0.387
Born on the island	1.859	2.944	0.529

7.10.2 Reasons not WTP for environmental management

The respondents that indicated that they were not WTP were asked about their main reason as to why they were not WTP. The outcome of this question is presented in Figure 5.13. The majority of the people that were not willing to pay indicated that they were in favor of more protection, but that this should be paid from existing tax revenues; followed by the option that they could not financially afford to contribute. That these two option are the main reason as to why the respondents were not willing to pay implies that they are still in favor of environmental management. Twelve percent of the respondents that were not willing to pay chose for a reason that was not already provided in the multiple choice question. The majority of those people indicated that pollution of the Simpson Bay Lagoon did not bother them. For example because they never went there or they were soon to leave the island.

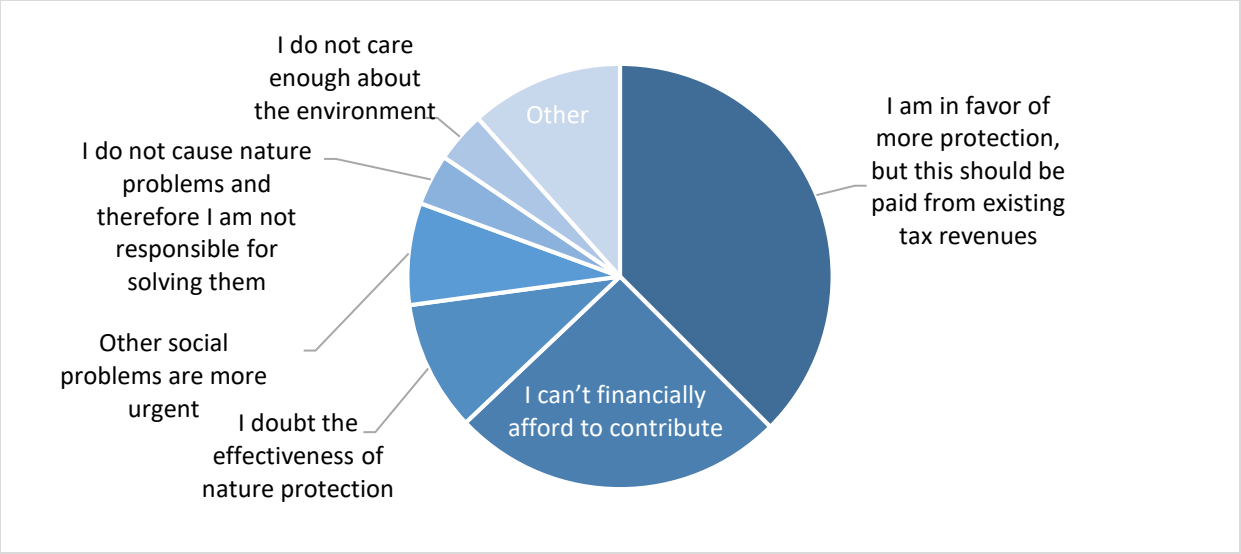

Figure 5.13: Main reasons for not WTP for environmental management of the Simpson Bay Lagoon

5.11 Equivalence between CV and CE method

This study made use of two different methods that asked for the WTP of the respondents: a CV and a CE. As mentioned above, the average WTP of the CV question was 13.76 dollar per household per month. The total WTP that was derived from the CE was 51.64 dollars per household per month. A one-way ANOVA test with additional descriptive statistics were performed to test whether these two methods were significantly different from each other. The results of the one-way ANOVA test shows that the average total WTP of the CV and CE are indeed significantly different ($p = 0.006$). The additional descriptive statistics show that the average total WTP of the CE is significantly higher than of the CV.

6. Discussion and conclusions

This study aimed to analyze how the socio-cultural context of Saint Martin influences the appreciation of different ESS provided by the Simpson Bay Lagoon. This chapter will draw conclusions from the obtained results and compare them to academic literature. Furthermore it will provide policy implications and recommendations for further research.

6.1 In what way does the appreciation of nature determine the value of ESS?

This study proposed a distinction between intrinsic, instrumental or relational value of nature. The results of this research do not show a significant relationship between the WTP for ESS delivered by the Simpson Bay Lagoon and these proposed types of appreciation of nature. In literature, similar theories that explain environmental behavior by different values exist, such as the one from Stern (Stern, 2000; Stern & Dietz, 1994; Stern, Dietz & Kalof, 1993), which also argued that three value orientations may affect attitudes associated to environmental behavior; an egoistic, a social-altruistic and a biospheric value orientation. People with an egoistic value orientation especially consider the costs and benefits of environmental behavior for themselves personally, the social-altruistic the costs and benefits for other people. People with a biosperic value orientation will mainly base their behavior on the costs and benefits for the ecosystem and biosphere as a whole, which is comparable to the 'intrinsic value' in the current study. The egoistic and social-altruistic values of Stern are comparable to the instrumental value that is proposed in the current study. The results of the current study show that respondents who thought the benefits provided by the lagoon were important for their own well-being were more WTP. Importance of the benefits for other people on Saint Martin was not a significant predictor for WTP. From these results can be concluded that the WTP behavior of the study population can be explained by an egoistic value orientation theory proposed by Stern.

However, the results of the CE show that respondents attached significant value to the attributes damage from storms, moderate and high water quality and habitat for species. It is interesting to see that the respondents were not WTP for the attributes that might contribute directly to the economy of the island (suitability for recreation and the amount of stay-over tourists). Which implies a more intrinsic attitude towards the value of nature. However, from the results of this research no straightforward conclusion can be drawn what type of attitude towards defines the appreciation of ESS delivered by the Simpson Bay Lagoon.

6.2 In what way does environmental behavior determine the appreciation of ESS?

In literature, a gap between possessing environmental knowledge and awareness and showing pro-environmental behavior is described. Many theories have been developed to explain this gap. Even though many studies have been conducted to test these theories, no definite answers have been found (Kollmuss & Agyemann, 2002). From the results of the current study can be concluded that respondents that considered themselves environmentally aware, also had a significantly higher total score for environmental behavior. Which indicated that there is no gap between environmental awareness and showing pro-environmental behavior for the community of Saint Martin. However, the current study did not include environmental knowledge, therefore no conclusions can be drawn about this concept.

From the results can be concluded that participation in pro-environmental activities predicts higher WTP for environmental management of the Simpson Bay Lagoon. In fact paying for protecting the environment can also be seen as a form of environmental behavior. One specific type of pro-environmental behavior that was asked in the survey was how often respondents donated money to an environmental cause, which is actually very similar to paying for environmental management of the Simpson Bay Lagoon. Therefore it was to be expected that the total score for environmental behavior would predict WTP for environmental management. Still, showing this relationship is important to show that by promoting people's environmental behavior, their WTP will increase as well.

Analysis of the socio-cultural background showed that that a higher level of education and origin predicted a higher score for environmental behavior and a higher self-reported environmental awareness. Also, the analysis showed that level of education and origin were related to each other. These results implicate that educating the population could positively change their environmental behavior and awareness, which might lead to a better environmental condition of the lagoon. Furthermore, education programs would be most effective for certain groups in society. Moreover, it was found that participation in recreational activities was positively related to pro-environmental behavior. Making recreation on the lagoon more accessible to all groups in society may increase pro-environmental behavior as well.

6.3 How do the different constituents of well-being relate to the appreciation of ESS?

This study found that respondents that perceived the benefits provided by the lagoon as important for their own well-being had a higher value of the lagoon. Also, the perception of the study population towards the relation between different constituents of well-being and the Simpson Bay Lagoon was investigated in this research. Respondents that perceived the cultural and historical aspect of the lagoon as important valued it more. This was also the case for respondents that thought the benefits of the lagoon were important for their income and for respondents that thought the lagoon was an important place to meet other people for social interaction. From these results can be concluded that well-being plays an important role in explaining the value Simpson Bay Lagoon has for the community of Saint Martin. Many studies have found an increase in human well-being with exposure to nature (Nisbet, Zelenski & Murphy, 2011; Howel, Dopko, Passmore & Buro, 2011). The results of the current study are in line with these results. This study focused on well-being in relation to the Simpson Bay Lagoon to a certain extent. However, as well-being is such a broad topic, it would be interesting to investigate the relationship between the natural environment of Saint Martin and the well-being of its inhabitants more extensively.

6.4 In what way does individual versus collective attitude determine the appreciation of ESS?

The results show that respondents that thought the benefits provided by the lagoon contributed to their own well-being valued the lagoon more. Contribution of the lagoon to the well-being of others did not predict a higher value of the lagoon. From comparing these results it can be concluded that the appreciation of ESS can be explained by an individual attitude and not by a collective attitude. However, it was also tested whether people that lived further away from the lagoon valued the lagoon less than people that lived inside the lagoon area. No significant relationship was found, which indicates a more collective attitude towards the value of the Simpson Bay Lagoon. Therefore, no overall conclusion can be

drawn whether individual or collective attitude determines the appreciation of ESS provided by the Simpson Bay Lagoon.

To what extent different actors, such as the private sector, or the local population contribute to the poor environmental condition of the Simpson Bay Lagoon has not been extensively studied. However, it can be concluded with certainty that the current environmental condition of the lagoon does not contribute to the well-being of the community of Saint Martin, let alone when it would deteriorate even more. A collective attitude from all involved actors in necessary, including the private sector, public sector and the population of Saint Martin, to improve the lagoons condition for the common good. Adequate rules should be established, based on the theories of Elinor Ostrom (Ostrom, 2015), that will allow everyone to benefit from the (economic) opportunities the lagoon has to offer up to a certain extent, in order to retain its natural beauty and maintain it for generations to come.

6.5 How does the socio-cultural context of Saint Martin influences the appreciation of ESS?

From the conclusions that are drawn to answer the research sub-questions of this research as described above can be concluded that different factors of the socio-cultural context determine the appreciation of ESS delivered by the Simpson Bay Lagoon. Such as some demographic variables (especially education level), the constituents of well-being, the participation in recreational activities and environmental behavior and awareness. Insight into this socio-cultural context will contribute to effective targeting of strategies to engage the public in improving the environmental quality of the Simpson Bay Lagoon. In addition to showing the societal value of the Simpson Bay Lagoon to decision makers.

6.6 Discussion of methods

Fourteen percent of the respondents chose for the opt-out option in the one or more of the choice cards. In the CV question, 33% of the respondents were not WTP for environmental management. Furthermore, on average, the total WTP for the CE was $51.64 per household per month compared to $13.76 for the CV. The difference between these values is quite large, and the one-way ANOVA test pointed out that these values were significantly different from each other. Though both methods are supposed to measure the WTP for the benefits provided by the Simpson Bay Lagoon, the outcomes differ a lot. One could question which of these values are the closest to the amount people would actually pay. In the CE it is clearer to the respondents what they are paying for, due to the pictograms and varying levels of the attributes. This might result in a higher average total WTP value for the CE. Also, as there were six different attributes, including the payment vehicle, respondents might have overlooked or underestimated the amount they would have to pay, because their attention might have been focused on the five other attributes. Furthermore, the expected future without extra management option was in this study not quite appealing, even though it was realistic. Therefore, when seeing the low levels of the six attributes, few people chose for this option. The CV question is a more direct and abstract way of asking respondent's WTP. Respondents were asked about their WTP for environmental management, but were not shown how this would result in actual improvement of the environmental condition of the lagoon, which might have resulted in lower WTP amounts. Furthermore, asking respondents directly about their WTP for environmental management might reflect more realistically what the respondents would actually pay.

A study that compared the outcomes of WTP obtained through CV and CE methods found different results throughout different studies. Some studies found a higher WTP in the CV compared to the CE, whereas

others found a higher WTP for the CE compared to the CV. (Mogas, Riera & Bennet, 2006). A study by Foster and Mourato (2003) suggests that CE and CV valuation approaches are appropriate for different purposes. The CV method shows a more general insight in how respondents value an ecosystem as a whole. The CE produces a set of single policy implications, as it shows the trade-offs between the different attributes. It will give an interesting insight into which ecosystem service is perceived most valuable and which ESS should therefore be the focus in policy measures. However, when these individual WTP values are added up, an over-estimation of the average total WTP may be the result (Foster & Mourato, 2003). For these reasons the most appropriate method must be carefully chosen.

6.7 Policy implications

Protecting the natural resources of Saint Martin is of major importance not only for the sake of nature itself, but also for sustaining the economy of the island. The majority of the island's income comes from tourism, and tourists mainly visit the island for the nice beaches, the scenery and to see the marine ecosystems with snorkeling and diving. Tourists will have less reason to visit Saint Martin if pollution and development continues, which might have severe impacts on the island in the future. Therefore it is important to undertake action in protecting the environment of the lagoon as soon as possible.

The results of the economic valuation show a high WTP for environmental management of the Simpson Bay Lagoon which indicates that people value this ecosystem greatly. Elderly respondents that grew up on the island remembered the lagoon as a clean and beautiful place where they would go swimming and catch lobsters. Very little of this beauty is still remaining. The high value of the lagoon in combination with the high support for the proposed management options that were found in this research indicate that the people of Saint Martin are ready for the implementation of measures to protect the lagoon.

The significant relationship of education with the different WTP values indicates that educating the public about the environment will positively influence their behavior. However, positive environmental behavior, such as recycling and the avoidance of littering, should also be facilitated. More bins should be placed in locations where people live and recreate. Furthermore, the recycling systems on both sides of the island should be improved, especially on the Dutch side.

Yet, changing the behavior of people alone will not solve the problem. Sewage pollution was perceived to be the most important problem related to the pollution of the lagoon. In the area around the lagoon there is currently no sewage treatment plant. People are supposed to have well-working septic tanks. However, these tanks are often not well maintained resulting in run-over of sewage into the lagoon. It could be argued that maintaining one's septic tank and ensuring safe treatment of sewage is the responsibility of the people themselves. However, people with a low income or people that still suffer from the destruction of hurricane Irma might not have proper sewage treatment as their priority. Also, proper regulation from the government is lacking or not enforced, which provides no incentive for people to properly dispose of their sewage. Building a sewage treatment plant and connecting all households in the area to it would drastically decrease the influx of sewage in the lagoon and therefore improve its environmental condition to a great extent. This management option was also supported by the respondents of this research. Also, regulations should be put in place for the disposal of sewage from boats in the lagoon. The lagoon harbors an extensive amount of boats that are not connected to any type of sewage treatment. Restricting these boats from releasing their sewage in the lagoon would improve its environmental condition. However, it is necessary that proper sewage disposal facilities are provided.

Furthermore, regulation should be put in place concerning boat repair workshops. Certain items that are used to maintain boats which are restricted in many parts of the world, due to their negative effect on the environment, are still being sold in boat repair shops on Saint Martin. Restricting selling these products would not only benefit the environmental condition of the lagoon, some of these products might also be harmful for the health of everyone that comes into contact with it. Moreover, regulation should be created that will restrict boats from performing maintenance (such as painting) on the water, which results in spill-over of paint and other hazardous chemicals directly into the Simpson Bay Lagoon.

In addition, engaging people to come more into contact with nature would make them realize the benefits ecosystems can bring to them. This is supported by the findings of this research that show that people that participate more in recreational activities also value the lagoon more. This could be done by making recreational activities more accessible to the general public. Free activities or discounts could be provided to people with a lower socio-economic status or families with children. Furthermore, types of recreation that can be done for free, such as fishing, spending time near the lagoon or walking, cycling or running around it could be stimulated by providing proper facilities.

Lastly, it should be made sure that the nature that is still remaining, such as the Mullet Pond and other areas that still contain extensive amounts of mangrove trees, should be protected to avoid destruction in favor of development.

6.8 Suggestions for further research

Some suggestions for further research have already been mentioned in the sub-chapters above. In addition to this, it would be useful to perform a policy analysis to reveal the actors that contribute to the problem; the ones that should act to protect the lagoon and the current governance structures that might contribute to the current mismanagement. Furthermore, an ecological assessment of the current environmental condition of the lagoon is necessary, which should involve, amongst other things, extensive water quality testing, evaluating the population status of species and the condition of their habitats, pointing out particular areas that are affected by garbage pollution and debris, and assessing the current state of the shipwrecks in the lagoon. Moreover, when this assessment is done, it could be investigated whether the perception of the problem (that can be derived from the results of this research) matches the actual condition of the lagoon. Lastly, unfortunately the Simpson Bay Lagoon is not the only ecosystem that is under threat on Saint Martin. Many other wetlands and ponds are suffering from environmental threats as well, in particular the Great Salt Pond. A similar study could be done to assess the value of this ecosystem, to show it is worth protecting as well.

Immediate action needs to be undertaken to put measures into place that will restore and protect the Simpson Bay Lagoon in order to maintain its huge benefit to the community of Saint Martin. The results of this study can be used to implement effective strategies to target the population of Saint Martin in order to engage them in protecting the Simpson Bay Lagoon.

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Annex I – Survey

Interview ID code	
Dutch or French side of Saint Martin	

Introduction

Thank you for participating in this survey. This survey is part of a research project of Environmental Protection in the Caribbean and VU University Amsterdam. The aim of this study is to show the benefits of improving the environmental condition of the Simpson Bay Lagoon for the community of Saint Martin.

This study is partly about the benefits that the Simpson Bay Lagoon provides to the people of Saint Martin. Examples of these benefits are food provisioning (in the case of the lagoon this could be fishing), recreational opportunities, tourism, biodiversity, storm protection, etc. We would like to hear your opinion about this topic. Everything that you tell us will be kept strictly confidential and the results will be analyzed anonymously. The survey will start with some general questions.

Would you be willing to participate in the survey?
[No], thank you for your time and have good day. (Continue to next address)
[Yes], thank you very much for cooperating. I will tell you a little bit more about the study.

I General questions

What is your gender?
a) Female
b) Male

Were you born on Saint Martin?
a) Yes
b) No

If not, where are you from?
a) Elsewhere in the Caribbean
b) Elsewhere in Latin America
c) Netherlands mainland
d) French mainland
e) North America
f) Refused
g) Elsewhere, specify:

How many years have you been living on Saint Martin?

How many people live in your household?

II Recreational activities on the lagoon

Please indicate in the table below how often you do the following activities near or on the lagoon.

	Never	**More than once a week**	**Once a week**	**Once a month**	**Once a year**
Boating/Sailing					
Spending time near the lagoon (on terraces, in bars, restaurants, etc.)					
Kayaking/Paddle boarding					
Swimming					
Walking/Jogging/Cycling					
Fishing					
Bird/Wildlife watching					
Other, please specify...					

III Environmental condition of the lagoon

Did you notice any changes in the lagoon's environmental condition in the past 10 years or since you arrived on Saint Martin?

a) Yes
b) No

Which changes have you noticed? You can pick multiple answers.

a) Bad smell coming from the lagoon
b) Dirty water
c) Trash and plastic pollution in the water/on the shores
d) Less fish in the water
e) Others, please specify...

How important do you consider the following reasons for the poor environmental condition of the Simpson Bay Lagoon?

	Not important	Not very important	Neutral	Somewhat important	Very important	I don't know
Sewage pollution						
Construction and development						
Garbage pollution						
Shipwrecks						
Mangrove destruction						
Invasive species (invasive plants, invasive fish, etc.)						

Who do you think is most responsible for the poor environmental condition of the lagoon? Please choose only one answer.

a) Tourists
b) Government
c) Businesses (restaurants, boat repair shops, etc.)
d) Local people
e) Other, please specify

IV Management activities

Are you in favor or not in favor of the following management activities to improve the environmental condition of the Simpson Bay Lagoon?

	Not at all in favor	Not in favor	Neutral	In favor	Strongly in favor	Don't know
Building a sewage treatment plant						
Restoration of mangroves						
Improving enforcement of environmental regulations						
Removing shipwrecks from the lagoon						
Restricting development (building of houses, hotels and marinas) along the lagoon						
Environmental awareness raising (education, campaigns)						

V Appreciation of nature

Do you think nature should be protected from human pollution (i.e. garbage, sewage, over-development, etc.)?

a) Yes
b) No

If yes, why? Choose the answer that best fits your opinion.
Nature should be protected...

a) For its own sake, it has an important value of its own
b) So humans can benefit from it (i.e. for recreation, etc.)
c) Because of its cultural and historical value

V Economic valuation (choice experiment and contingent valuation)

The following questions ask you to make a choice between three scenarios for the future state of the environment of the Simpson Bay Lagoon. The scenarios are described in terms of the following aspects:

1. *Damage from storms* refers to the damage from storms to properties nearby the lagoon. Mangroves around the lagoon provide important protection from storms.
2. *Water quality* refers to the quality of the water in the Simpson Bay Lagoon. This takes into account the clarity of the water and the smell of the water.
3. *Habitat for species* refers to the extent to which the lagoon can provide a habitat for species (fish, turtles, birds). Many species find a habitat in the seagrass beds and mangrove stands that are present in the lagoon.
4. *Suitability for recreation* refers to the suitability of the lagoon for recreational activities (fishing, sailing, swimming, barbecuing, bird watching).
5. *Stay-over tourists* refers to the number of stay-over tourists that come to the island of Saint Martin.
6. The *contribution per month* that would be contributed financially by **all households of Saint Martin** and would be used strictly for the environmental management of the Simpson Bay Lagoon.

Please give the tablet back to the interviewer. He or she will record your responses so that you can focus on the choice cards.

What is the version of the choice set (very important!)? There are 4 versions, fill in the version that is used.

You will be asked to make a choice **six times**. In each question, the options on offer will be different. Try to imagine in which situation you would prefer to be, taking into account the payment, and then choose that option. (**Show on the example choice card that the items for one scenario belong together and indicate that he/she should choose one of the three scenarios.**) Be aware that none of the choices has a clear-cut best scenario and that you will need to make trade-offs between the different aspects. There are no wrong answers - we are only interested in your opinion!

Please look at the 3 options shown in the example card. To make a choice between the 3 options you should look at all of the items that shape the option (storm surge protection, water quality, yearly contribution, etc.).

- In **Option A** the damage from storms to properties nearby the lagoon will reduce with 20%. The water quality will be high, with clear water and no bad smell. Habitat for species will increase with 20%. Suitability for recreation will be high. The number of stay-over tourists will increase with 20%. You pay $240 per year ($20 per month).
- In **Option B** the damage from storms to properties nearby the lagoon will stay the same as it is now. The water quality will be moderate, with occasional bad smell and areas of clear and unclear water. Habitat for species will stay the same as it is now. Suitability for recreation will be moderate. The number of stay-over tourists will stay the same as it is now. You pay $60 per year ($5 per month).
- In **Option C** the damage from storms to properties nearby the lagoon will increase with 20%. The water quality will be low, with bad smell and unclear water. Habitat for species will decrease with 20%. Suitability for recreation will be low. The number of stay-over tourists will decrease with 20%. You do not have to pay a yearly contribution.

Options A and B are different in each question and option C is the same every time. Please note that none of the options will be perfect and that some decisions may be difficult or involve making a trade-off. Every card represents a new choice and has nothing to do with the previous choice.

Record the respondent's answers to each choice question in the table below. (Check only one box per row).

	Option A	Option B	Option C	Declined to answer
Choice card 1				
Choice card 2				
Choice card 3				
Choice card 4				
Choice card 5				
Choice card 6				

How certain are you about the choices you just made?

Very uncertain				Very certain
1	2	3	4	5

(Only ask the following question if the respondent has chosen option C every time or declined to answer, otherwise skip question)

In making your choices, how important were the following aspects to you?

	Not at all important	Not important	Neutral	Important	Very important	I don't know
Annual contribution in US $						
Damage from storms						
Water quality						
Habitat for species						
Suitability for recreation						
Tourism						

How did you make your choices? Did you:

a. Consider all aspects
b. Consider a few specific aspects
c. Only consider one specific aspect
d. Use your intuition
e. Make a random choice
f. Don't know

Contingent Valuation

Are you in principle willing to pay for environmental management of the Simpson Bay Lagoon?

a. Yes (skip next question)
b. No (go to following question)

What is the main reason you are not willing to pay for environmental management of the Simpson Bay Lagoon? (Tick only one reason) (After this question, go to the next section)

a. I do not care enough about the environment
b. I am in favor of more protection, but this should be paid from existing tax revenues
c. I can't financially afford to contribute
d. I doubt the effectiveness of nature protection
e. Other social problems are more urgent
f. I do not cause nature problems and therefore I am not responsible for solving them
g. Other, specify…

What is your maximum amount of monthly contribution you are willing to pay for environmental management of the Simpson Bay Lagoon? In making a choice, carefully take into account whether you actually can and are willing to pay this amount given your current income level.

$ per month ….

$0	$2	$4	$8	$15	$30	$65	$125
$1	$2.50	$5	$10	$20	$40	$80	More than $125
$1.50	$3	$6	$12.50	$25	$50	$100	Don't want to say

How certain are you about the choice you just made?

Very uncertain				**Very certain**
1	**2**	**3**	**4**	**5**

Which organization should manage the funds for the environmental management of the Simpson Bay Lagoon? Check the most preferred answer.

a. Government of Dutch Saint Martin
b. Territorial council of French Saint Martin
c. Government of the Netherlands
d. Government of France
e. VNP Sint Maarten: The Dutch Representation in Sint Maarten
f. Local environmental organizations (EPIC, Nature foundation, Le Fruit de Mer)
g. Don't know/no preference
h. Other, specify:

VII Environmental behavior and perception

How often did you do the following activities in the past year?

	Never	Rarely	Sometimes	Often	Very Often
look for environmental information (on internet, TV, newspaper, radio, etc.)					
Attend public meeting or events related to the environment					
Donate money to an environmental cause (e.g. Nature Foundation/ EPIC)					
Do any voluntary environmental work (e.g. clean up beach/nature)					
Purchase environmentally friendly products (reusable bags, etc.)					
Walk or bike instead of driving					
Recycle your waste (plastic, carton, glass, etc.)					
Avoid littering, encourage other people not to litter					
Properly dispose of hazardous chemicals (oil, paint, etc.) that should not be poured down the drain					

To what extent to you agree or disagree with the following statements? Please indicate in the table below

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know
I consider myself environmentally aware						
Hurricane Irma has increased my awareness about the natural environment						
Compared to other people on Saint Martin, I was less affected by hurricane Irma						
The pollution of the lagoon has a negative effect on my health						
The area around the lagoon is an important place to meet other people for social interaction						
I feel involved in the decision making process of the management of the lagoon						
The benefits provided by the lagoon are important for my own well-being						
The benefits provided by the lagoon are important for the well-being of other people on Saint Martin						

The benefits provided by the lagoon are important for my income						
The cultural and historical aspect of the lagoon is important to me						

VII Demographics

How old are you?

a. 18-25
b. 26-35
c. 36-45
d. 46-55
e. 56-65
f. 66+

In which field are you employed?

a. Retail
b. Hotels, restaurants and other hospitality services
c. Government
d. Construction
e. Electricity, gas and water
f. Education
g. Transportation and Storage Services
h. Rental and Leasing Activities
i. Healthcare
j. Care and Social work
k. Tour activities (e.g. diving, jeep tours, etc.)
l. Retired
m. Not employed
n. Refuse to answer/Don't know
o. Other, specify

What is the highest level of education that you have completed?

a. No education
b. Primary school
c. High school
d. Vocational school / technical school (MBO, CFA)
e. Higher education: University of applied sciences (HBO)
f. Higher education: University bachelor
g. Higher education: University master
h. Don't know/refuse
i. Other, specify

May I ask your gross household income in US $ last month?

a. <500
b. 500-999

c. 1000-1499
d. 1500-1999
e. 2000-2499
f. 2500-3499
g. 3500-4999
h. 5000-6999
i. 7000-9999
j. >10000
k. Don't know/refuse

VII Conclusion

Are there any other issues or suggestions that you would like to share related to marine pollution in the lagoon?

Thank you very much for participating in this survey. Your participation will contribute to the improvement of the environmental quality of the Simpson Bay Lagoon.

Annex II – Preliminary Choice Experiment

Attribute	Level 1	Level 2	Level 3 (no change)
Flood protection *Frequency of extreme flood events*	Once in every 10 years	Once in every 20 years	Once in every 5 years
Fisheries *Fish catch per trip*	No change	20% higher catch	20% lower catch
Water quality *Is it healthy to swim*	Moderate, most of the time swimming does not pose health risks	High, swimming does not pose health risks	Low, swimming poses health risks
Biodiversity *Habitat for species in the lagoon*	No change	20% more habitat for species	20% less habitat for species
Suitability for recreation	Moderate	High	Low
Tourism *Change in number of tourists per year*	10% more	20% more	20% less
Payment vehicle (annual donation)	$90 ($7.50 per month)	$180 ($15 per month)	$0

Annex III – Overview of expert and stakeholder meetings

Tours around the Simpson Bay Lagoon
We were introduced to Rueben Thompson, a board member of EPIC. Rueben gave us a tour of the Dutch side of the island, with a particular focus on the area around the lagoon. During the tour Rueben showed us the particular areas of environmental challenge. This meeting provided us with very useful insights into the extent of the problem and the context of our research.

Furthermore, we were introduced to Tadzio Bervoets, a former ERM student and the director of Nature Foundation Sint Maarten. Rueben and Tadzio took us on a boat tour around the Simpson Bay Lagoon to show us its environmental challenges and most polluted areas. They also took the team to the site of mangrove restoration, a joint project of EPIC and Nature Foundation.

Meeting with Kippy Gilders and VROMI staff
We met with Kippy Gilders, a previous ERM student and former EPIC staff member, currently working for the government of the Dutch side at the department of public housing, spatial planning, environment and infrastructure (VROMI). She introduced us to her colleagues Melissa Peterson, Ruud van Diepen and Johann Sidial. The focus of this meeting was to obtain feedback on our project, and in particular to discuss the attributes and their respective levels of the preliminary choice card to make sure they were relevant to the local context.

Annex IV – pictures showing lagoon's poor environmental condition

Shipwrecks in the Simpson Bay Lagoon

A gutter containing sewage next to the road in Cole Bay area

Algea bloom in the Simpson Bay Lagoon