

MSc Programme in Urban Management and Development

Rotterdam, the Netherlands

September 2021

The social, economic, and environmental benefits of nature-based solutions on the adaptive capacity of local communities to climate change.

A case study of the mangrove restoration project in Weg naar Zee, Suriname.

Name: Dion Wip

Supervisor: Elena Marie Enseñado

Specialisation: Urban Environment, Sustainability and Climate Change (UESC)

Country: Suriname

Report number: 1521

UMD 17

Summary

Climate change its effects on low-lying coastal areas entail a wide variety of issues such as increases in the frequency and intensity of erosion and floods. To address these climatological issues, there is a need for these low-lying coastal areas to increase their adaptive capacity regarding climate change. This need to address the multitude of climate-related issues more sustainably has contributed to the usage of Nature-based Solutions (NbS), which make use of ecosystems services derived from these NbS. However, thus far there is a knowledge gap concerning the relationship between the social, economic, and environmental ecosystem benefits derived from such NbS and their effects on the adaptive capacity and level of vulnerability of coastal areas. The aim of this study is therefore to contribute to this knowledge gap.

With regards to the methodology, the research made use of the case study approach in which the “Building with Nature” project in the Weg naar Zee (WnZ) area, along the coast of the city of Paramaribo, was assessed. This project tries to address the climate-related issues occurring in this area by rehabilitating the mangrove ecosystems. For the primary data collection, the combination of 6 semi-structured interviews along with the administration of 165 questionnaires were used. This analysis of data had the main purpose of identifying the different social, economic, and environmental benefits provided by the mangrove NbS and their influence on the adaptive capacity, natural and socio-economic vulnerability of the WnZ area.

The findings of the study point out that the project has contributed to the provisioning of ecosystem services (ES) in all three categories of social, economic, and environmental benefits, with the more profound benefits being within the social and environmental categories. The results furthermore point out that the project has contributed to different adaptive capacity aspects, while also influencing the level of vulnerability within said area.

The main research findings establish that there is a relationship between the three different main concepts of ES, adaptive capacity, and vulnerability. The main relationship within the project is between the ES provided, especially that of educational services, and the access to formal and informal learning, which increases adaptive capacity in the area. Moreover, these increases in adaptive capacity influence the vulnerability of the area indicating the direct connection between adaptive capacity and vulnerability and the indirect connection between ES and vulnerability. However, from the results, it can further be derived that certain ES provided can also directly influence the vulnerability of an area.

Keywords

Nature-Based Solutions, Ecosystem Services, Adaptive Capacity, Natural and Socio – economic Vulnerability, Climate change, Mangroves

Acknowledgements

Throughout the process of writing this thesis, I have had the privilege of receiving assistance and support from multiple people.

I would like to firstly thank my supervisor, M.Sc. Elena Marie Enseñado from the Institute of Housing and Urban Development Studies of Erasmus University Rotterdam for her expertise, invaluable guidance, support, and understanding during the study and thesis period. Her feedback has helped me sharpen and streamline my thesis from the first chapter until the last. I would also like to thank my second reader Dr. Paul Rabé from the Institute of Housing and Urban Development Studies of Erasmus University Rotterdam for his clear and well-advised comments and feedback.

I would also like to show my appreciation to the Netherlands Universities Foundation for International Cooperation (NUFFIC) for granting me a scholarship via the Orange Knowledge Programme (OKP). This scholarship has enabled me to gain knowledge regarding Urban planning and Management while simultaneously broadening my horizon.

Furthermore, I would like to thank the local respondents of the WnZ area, the representatives of the local farmers' organization, Conservation International Suriname (CIS), Foundation Forest management and Surveillance (SBB), World Wide Fund for Nature (WWF), The United Nations Development Programme (UNDP) and professor S. Naipal for sharing their knowledge and experiences with me.

Lastly, I would like to express my deepest gratitude to my relatives, friends, and especially my brother and parents for their never-ending support and motivation throughout this challenging year, enabling me to reach this achievement.

Dion Wip

2021

Abbreviations

CIS	Conservation International Suriname
ES	Ecosystem Services
LECZ	Low Coastal Elevation Zone
MAFOSUR	Mangrove Forum Suriname
NbS	Nature Based Solutions
SBB	Foundation Forest management and Surveillance
WWF	World Wide Fund for Nature
STU	Sediment Trapping Unit
UNDP	The United Nations Development Programme
WnZ	Weg naar Zee

Table of Contents

Summary	ii
Keywords	ii
Acknowledgements	iii
Abbreviations	iv
Table of Contents	v
List of Figures	vii
List of Tables	vii
Chapter 1: Introduction	1
Background Information.....	1
Problem statement	2
Research objectives	3
Main Research Question.....	3
Sub – Research Questions	3
Significance of the study/contribution.....	3
Chapter 2: Theory Review	4
2.1 Introduction	4
2.2 Mangroves as Nature-based Solutions.....	4
2.3 Ecosystem services	4
2.3.1 Definitions of Ecosystem Services.....	4
2.3.2 Coastal Mangrove Ecosystem Services.....	5
2.4 Vulnerability	7
2.4.1 Vulnerability to climate change	7
2.4.2 Coastal Vulnerability Suriname	7
2.5 Adaptive capacity	8
2.5.1 Climate Change related Adaptive Capacity	8
2.5.2 Coastal Adaptive Capacity	9
2.6 Relationship between Ecosystem services, Adaptive Capacity, and Vulnerability.....	10
2.7 Conceptual framework	11
Chapter 3: Research Design and Methods	12
3.1 Introduction	12
3.2 Research Strategy	12
3.2.1 Validity and Reliability	12
3.3 Operationalization	12
3.4 Data Collection Methods & Sample Size Selection	20
3.4.1 Data Collection Methods.....	20
3.4.2 Sampling Technique.....	20
3.5 Data Analysis Techniques	23
3.6 Challenges and Limitations	23
Chapter 4: Research Findings	24
4.1 What social, economic, and environmental benefits does the “Building with nature” (NbS) project contribute to the WnZ area?	24
4.1.1 Environmental Benefits of the Project	24
A. Halting of land degradation by gathering and stabilizing sediment.	24
B. Increase in biodiversity	24
4.1.2 Economic Benefits of the Project.....	25

4.1.3 Social Benefits of the Project	26
A. Educational Services Provided	27
B. Involvement in Nature-based solution projects.....	27
C. Regeneration of mangrove forest.....	28
D. Recreational uses provided	28
E. Cultural and or spiritual services provided and or maintained.....	28
4.2 What is the current Adaptive Capacity of the Local Citizens of the Weg naar Zee area?.....	29
4.2.1 Availability of Assets to the Local Citizens of the Weg naar Zee area.....	29
A. Access to finance.....	29
B. Well-being of local Citizens	29
4.2.2 Flexibility of the Weg naar Zee area.....	30
A. Flexibility to switch between climate-related strategies	30
4.2.3 Social Organization contributed by the Project to the Weg naar Zee area.....	30
A. Local participation and awareness regarding climate change and mangroves.....	31
B. Formal and informal cooperation between communities and stakeholders.....	31
4.2.4 Level of Learning with regards to Climate Change taking place within the Weg naar Zee area.....	32
A. Access to formal and informal learning regarding climate change and mangroves.....	32
4.2.5 Level of Agency taking place within the Weg naar Zee area due to the “Building with nature” project.....	33
A. Willingness to address Climate-related Issues.....	33
4.3 What is the level of socio-economic and natural vulnerability of the local citizens of the WnZ area?	33
4.3.1 Socio-economic Vulnerability of the Local Citizens to Climate Change.....	33
A. Average Income	33
B. Population density	34
C. Presence of recreational and social facilities	34
D. Level of education	35
4.3.2 Natural Vulnerability of the Local Citizens to Climate Change.....	35
A. Level of risk of erosion within the Weg naar Zee area.....	35
B. Level of risk of flooding within the Weg naar Zee area	36
4.4 In what way do the social, economic, and environmental benefits of “Building with nature” (NbS) project influence the adaptive capacity of the local citizens of the Weg naar Zee area in addressing climate-related socio-economic and natural vulnerability?	37
4.4.1 Social, Economic, and Environmental benefits their influence on the Adaptive Capacity.....	37
4.4.2 Adaptive Capacity its influence on socio-economic and natural vulnerability.....	38
4.4.3 Social, Economic, and Environmental benefits their influence on the socio-economic and natural vulnerability	39
Chapter 5: Conclusions and recommendations	41
5.1 Conclusion.....	41
5.1.1 Sub-Research Question 1: What is the level of socio-economic and natural coastal vulnerability of the local citizens of the WnZ area?	41
5.1.2 Sub-Research Question 2: What is the current adaptive capacity of the local citizens of the WnZ area?	41
5.1.3 Sub-Research Question 3: What social, economic, and environmental benefits does the “Building with nature” (NbS) project contribute to the WnZ area?.....	42
5.1.4 Main Research Question: In what way do the social, economic, and environmental benefits of the “Building with nature” (NbS) project influence the adaptive capacity of the local citizens of the Weg naar Zee (WnZ) area, Suriname in addressing climate-related socio-economic and natural vulnerability?	43
5.1.5 Reflection Conceptual Framework.....	43
5.2 Suggestion for Future Work	44
Bibliography	45
Annex 1: Research Instruments and Time schedule	50
Annex 2: Correlation tables	52
Annex 3: IHS copyright form	55

List of Figures

Figure 1: Weg naar Zee area	2
Figure 2: ES provided.....	5
Figure 3: Total economic value of mangrove ecosystems	6
Figure 4: Five disciplines of adaptive capacity.	9
Figure 5: Conceptual Framework	11
Figure 6: Sampling areas.....	21
Figure 7: Revised Conceptual Framework	44

List of Tables

Table 1: Mangrove Ecosystem Services and its categorization	6
Table 2: Main Concept Definitions.....	13
Table 3: Operationalization	14
Table 4: Interviewees table	22
Table 5: Questionnaire results Environmental Benefit indicators.....	24
Table 6: Questionnaire results Economic Benefit Indicators.....	25
Table 7: Questionnaire results Social Benefit Indicators	27
Table 8: Questionnaire results Asset indicators	29
Table 9: Questionnaire results Flexibility indicator.....	30
Table 10: Questionnaire results Social organization indicators.....	30
Table 11: Questionnaire results Learning indicators.....	32
Table 12: Questionnaire results Level of Agency indicator.....	33
Table 13: Questionnaire results Average income.....	34
Table 14: Questionnaire results Population density.....	34
Table 15: Questionnaire results Recreational and social facilities.....	34
Table 16: Questionnaire results Level of education.....	35
Table 17: Questionnaire results Natural Vulnerability indicators	35
Table 18: Co-Occurrence Ecosystem Services and Adaptive Capacity.....	38
Table 19: Co-occurrence Natural Vulnerability and Adaptive Capacity.....	39
Table 20: Co-occurrence Natural Vulnerability and Ecosystem Services.....	40
Table 21: Thesis Timetable, 2021.	51

Chapter 1: Introduction

Background Information

The impact of sea-level rise as a climate change issue is problematic for coastal populations, which encompass more than a third of the earth's total population; with approximately a tenth of said population living within 10 meters of sea level. Furthermore, the low-lying coastal areas tend to become more prone to coastal erosion and flooding due to the increase in frequency and intensity of climate-related issues (Gedan et al., 2010).

The construction of grey infrastructures such as dams, storm barriers, sea walls, and dikes are used as a response to the threat of sea-level rise within prone coastal areas. However, this grey infrastructure has proven to be case-specific and not flexible enough to adjust to the changing environmental conditions caused by climate change. This uncertainty of the climate adds budgetary risk regarding the longevity and the maintenance of such constructions. However, there is a growing awareness that ecosystems can play an important role in the level of vulnerability and adaptive capacity of areas.

With vulnerability being described as the level of susceptibility and ability of a system to manage unfavorable climate change-related effects and its different intensities and extremes. Thus, the level of vulnerability is seen as an internal property of a system due to the unique exposure of systems to these climate-related impacts and the unique socio-economic characteristics present within said system (Sharma & Ravindranath, 2019).

Furthermore, adaptive capacity has been described as a process in which external impacts and stresses such as climate change and its effects are anticipated thereby, reducing, or avoiding distress while also exploiting opportunities (IPCC, 2014; Raymond et al., 2017). This awareness of the importance of ecosystems on the adaptive capacity and vulnerability of a system has contributed to the creation of "Nature-based solutions" (NbS). These NbS encompass actions such as the creation of parks, green spaces, and afforestation projects. From a low-lying coastal point of view, it can be derived that NbS such as mangroves, oyster beds, salt marshes, and coral reefs help reduce coastal erosion and storm-related damages.

NbS have received more attention and have become more prominent as solutions for climatological issues, due to its ability to use ecosystem services (ES) to address multiple aspects at once, enabling easier adaptation to environmental shocks (Raymond et al., 2017; Kopsieker et al., 2021). These ES are defined as the direct and indirect contributions of ecosystems to human well-being (TEEB, 2011). This wide spectrum of benefits provided by NbS such as coastal erosion protection, flood peak reduction, improved diversity of flora and fauna, improved public health, accessibility to public green spaces, increased physical activity, tourism, and creation of additional jobs within the green sector, can be categorized within the environmental, social, and economic aspects of NbS (Raymond et al., 2017 & Faivre et al., 2017).

However, the implementation of NbS is not without its challenges and uncertainties. This is due to the difficulty to predict ecosystems' response to varying intensities and frequencies of climate-related impacts and the level of protection that can be offered in certain geographical and ecological situations. This unpredictability of NbS to handle climate-related impacts is due to the lack of assessment of NbS projects and their results, resulting in the lack of knowledge and experience regarding the capabilities of NbS (Seddon et al., 2019).

Problem statement

The developing country of Suriname deals with a variety of climate-related issues, with that of sea-level rise being the biggest threat to the nation, causing saltwater intrusion, flooding, erosion, and loss of biodiversity (Surinamese national adaptation plan, 2019). The fact that the country is categorized as a Low Coastal Elevation Zone (LECZ), further clarifies why Suriname is in the top ten countries affected by a 1-meter rise in sea level in the world. (World Bank, 2017).

This vulnerability is clearly visible within the Weg naar Zee (WnZ) area located within the capital of Paramaribo (Conservation International, 2021) and is the result of mangrove deforestation which removed ecosystems that play a substantial role in protecting against coastal erosion. This has reduced the areas' ability to mitigate the impact of coastal climate-related issues, resulting in a coastal retreat of 1.3 km in 30 years (Vohland et al., 2012). The construction of dikes took place to safeguard the 3000 directly affected inhabitants of the WnZ area (Conservation International, 2021). However, these failed to withstand the forces, resulting in the flooding of the coastal WnZ area in February of 2015 (Cete et al., 2018).



Figure 1: Weg naar Zee area (Google Earth; Waterkant, 2020).

The NbS approach has been adopted by the Anton de Kom University led by professor Sieuwnath Naipal and Conservation International regarding the WnZ area. This initiative called “Building with nature” has the goal of halting land degradation by using ecological adaptation techniques and does so by conserving, protecting, and restoring mangrove forests along the coastal line. The bamboo sediment trapping unit (STU) technique is used to attain a healthy and adequate amount of sediment which, serves as the basis for the afforestation of the Mangrove Forest. This approach was deemed to be more adequate for the situation in Suriname due to the lack of government funds to construct the traditional grey infrastructure needed for coastal protection. The success of the pilot phase resulted in additional funding through the funding program “Friends of Green Suriname” in which an amount of USD 20.000, - was collected for the continuation of the project (IDB, 2021; Wetlands International, 2021).

The focus of the pilot was on the technical success factors and design requirements needed for the implementation of the project and contributed to the evidence base that mangrove forests can be used to protect against coastal erosion (Cete et al., 2018). From Giordano et al (2020) and Kabish et al. (2016), it can be derived that there is a lack of frameworks that assess the value of NbS, resulting in a lack of knowledge regarding the synergies between economic, social, environmental, and adaptive factors. This is also the case in this project in which no attempt has been made to assess the social, economic, and environmental benefits which the project has contributed to the area and its locals. For this reason, it is necessary to study the “Building with nature” project in WnZ, Suriname to fill the knowledge gap regarding the social, economic, and environmental benefits derived from NbS which influence the adaptive capacity and vulnerability of the area (Cete et al., 2018; Kabish et al., 2016).

Research objectives

The objective of the study is to explain how the social, economic, and environmental benefits derived from the “Building with Nature” NbS project contribute to the adaptive capacity of the local citizens of WnZ in addressing their climate-related socio-economic and natural vulnerability. The sub-objectives are the following:

- To investigate the level of socio-economic and natural vulnerability of the local citizens of the WnZ area.
- To examine the current adaptive capacity of the local citizens of the WnZ area.
- To determine the social, economic, and environmental benefits that the “Building with nature” NbS project contributes to the WnZ area.

Main Research Question

In what way do the social, economic, and environmental benefits of the “Building with nature” (NbS) project influence the adaptive capacity of the local citizens of the Weg naar Zee (WnZ) area, Suriname in addressing climate-related socio-economic and natural vulnerability?

Sub – Research Questions

- What is the level of socio-economic and natural coastal vulnerability of the local citizens of the WnZ area?
- What is the current adaptive capacity of the local citizens of the WnZ area?
- What social, economic, and environmental benefits does the “Building with nature” NbS project contribute to the WnZ area?

Significance of the study/contribution

From a social perspective, the study contributes to the identification of the social, economic, and environmental benefits that the “Building with nature” project contributes to the WnZ area. This added knowledge contributes to the building of capacity of locals of the area thereby, establishing a foundation to exploit these benefits for its further development. Furthermore, this study contributes to closing the knowledge gap by studying the social, economic, and environmental benefits of NbS and its connection to adaptive capacity and vulnerability and does so by evaluating the case study of the “Building with nature” project. Thereby, contributing to the creation of an evidence base regarding the different benefits of NbS, making future investments and policy implementation of NbS more reliable under equally comparable circumstances.

Chapter 2: Theory Review

2.1 Introduction

The following chapter will focus on the relevant theories that will create a theoretical basis on which further research can be built. This chapter does this by discussing mangrove forests as NbS, the ES provided, coastal vulnerability and adaptive capacity, and concludes with the conceptual framework which visually represents the interlinkages between these concepts.

2.2 Mangroves as Nature-based Solutions

The umbrella concept of NbS has been defined by the International Union for Conservation as “actions to protect, sustainably manage, and restore (create) natural or modified ecosystems that address societal challenges (including urban ones) effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits” (Almenar et al., 2020, p.2). These actions encompass and support various related concepts such as green and blue infrastructure, ecological engineering, ecosystem-based adaptation, sustainable urban drainage systems, and ES (Eisenberg & Polcher, 2019).

When assessing the different forms of NbS implementation such as protection, restoration, and management it becomes apparent that the usage of mangroves to address global societal issues such as the effects of climate change is common due to the wide variety of ES that it can provide. These specific mangrove ES provided to coastal areas will be touched upon in detail in section 2.3.2. The possibility of implementation of mangroves within an area is however dependent on the geographical location of the area (Gandhi and Jones, 2019). These areas for possible implementation of mangrove NbS must have tropical to sub-tropical climate conditions that support mangroves, which enables projects regarding protection, restoration, and management to take place. These forms of mangrove NbS implementation can contribute a wide variety of ES to the local coastal communities such as educational uses, carbon storage, biodiversity, and coastal protection from climate-related hazards and can be seen as a cheaper coastal protection option for developing countries such as Suriname (Gandhi and Jones, 2019).

2.3 Ecosystem services

2.3.1 Definitions of Ecosystem Services

From the previous section, it becomes apparent that NbS of any type can contribute to multiple benefits derived from ecosystem functions which, can directly or indirectly affect the human population and areas where they are implemented (Vohland et al., 2012). These benefits can be placed under the term ES. However, these ES do not only include the provisioning, delivery and production of benefits but also encompass the maintenance of the produced services, which are perceived as important by the human population using them (Vo et al., 2012). Different scholars and organizations have tried to define these ES by comprehending the characteristics delivered by these services. There have been broad definitions that tried to comprehend these characteristics such as the previously mentioned definition from TEEB, (2011). However, from Vo et al, (2012, p. 432) a more detailed definition is given, which defines these ES as “benefits provided by ecosystems to humans, which contribute to making human life both possible and worth living. This includes goods such as food crops, seafood, forage, timber, and biomass.”

From the above-mentioned definitions, it can be derived that the ES provided can be placed on a wide spectrum of types of services, namely: provisioning services, supporting services, regulating services, and cultural services as seen in figure 2.

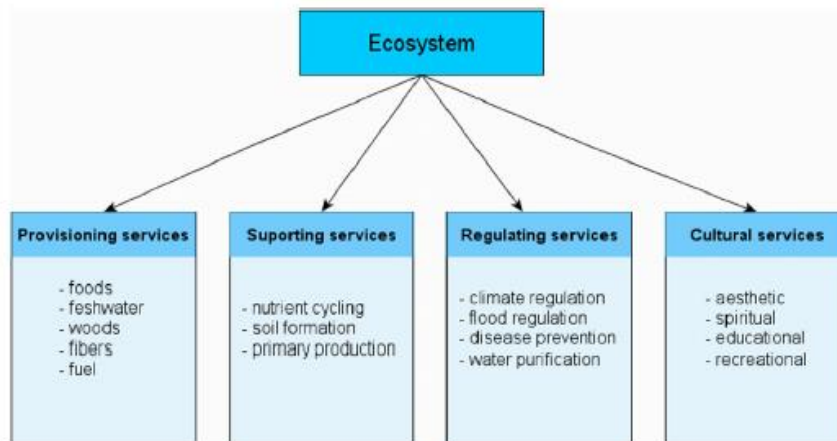


Figure 2: ES provided (Vo et al., 2012)

2.3.2 Coastal Mangrove Ecosystem Services

Coastal zones inhabit 4% of land and approximately 11% of the total ocean area around the world while being one of the most productive ecosystems with regards to the ES offered. These ES provided contribute to the appeal of these coastal zones, making them an optimal zone for economic and ecological activity. However, despite these facts, coastal ecosystems are considered one of the most endangered, due to the human-induced pressures such as pollution, deforestation, and overexploitation, resulting in the reduced availability of coastal ES (Himes-Cornell, 2018).

More specifically focusing on mangroves in the coastal area, it can be noticed that mangroves are seen as the ecosystem which connects the terrestrial and the aquatic ecosystems. They play an important role in providing direct and indirect benefits to the area of implementation which can include the maintenance of biodiversity, waste assimilation, cleansing, recycling, and improvement of public health, while also protecting coastal areas against storm surges, sea-level rise, and coastal erosion (Vo et al., 2012).

Mangroves possess the ability to address multiple societal challenges which can include ecosystem restoration, increasing carbon storage capacities, urban regeneration, watershed management, enhancing coastal resilience to climate-related impacts, and increasing human well-being. This positive effect on well-being is underlined by the proven correlation between healthy natural environments and the decrease in morbidity and mortality rates of the population, indicating its importance for especially vulnerable populations (Faivre, 2017).

Mangroves also provide environmental benefits such as the unique capability to gather and stabilize sediment while, controlling low wave energy-induced erosion of near shorelines. This is due to the positive correlation between sea-level rise and sedimentation rate (Gedan et al., 2010; Himes-Cornell, 2018). Secondly, mangroves act as natural filters which decrease the concentration of suspended particles thereby, improving water quality. Thirdly, they can be seen as natural nurseries and habitats for coastal fisheries and birds such as shrimp and crabs (Toornman et al., 2018). Lastly, these ecosystems are more effective than land-based forests for short- and long-term carbon storage (Himes-Cornell, 2018).

The economic benefits of mangrove forests are a combination of the social and environmental benefits provided. The valuation of these ES is more difficult to assess due to ES its context specificity and the fact that ES are provided for free and have no measurable market value (Vo et al., 2012). However, from Himes-Cornell (2018) it is derived that the economic value assigned to an ES is first measured with regards to human welfare and how a change in that ES impacts the well-being of individuals, which is then translated into economic terms. These

economic ES provided can be categorized as follows: direct use values, which are products that are used directly from the mangroves, indirect values which are ES that support economic activities, option value which encompasses future direct and indirect values, while existence value is that which is brought forward by its existence alone. However, there is more concrete evidence of the economic benefits of mangroves such as the ability to create the opportunity for green jobs, facilitate tourism within an area, and the ability to reduce coastal impacts such as storm events. Thereby, directly reducing the economic damages to livestock, agriculture, fisheries, properties, infrastructure, and other assets (Gedan et al., 2010).

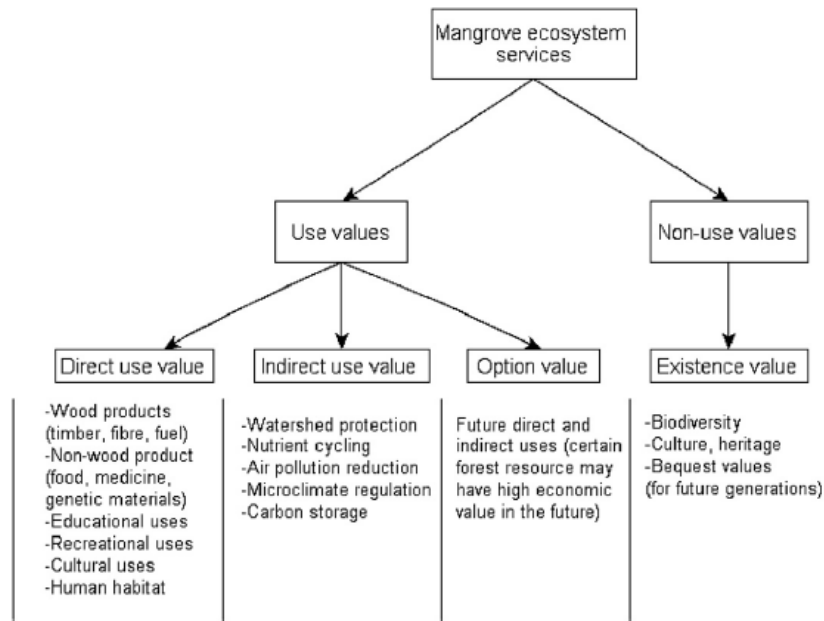


Figure 3: Total economic value of mangrove ecosystems (Vo et al., 2012)

From the previous sections within chapter 2, it can be derived that the multitude of provided mangrove ES can be categorized within the social, economic, and environmental aspects. This categorization can be seen in the table below.

Table 1: Mangrove Ecosystem Services and its categorization (Favre, 2017; Gedan et al., 2010; Himes-Cornell, 2018)

Mangrove Ecosystem Services		
Social	Environmental	Economic
<ul style="list-style-type: none"> - Ecosystem restoration. - Increasing CO₂ storage capacities. - Urban regeneration - Watershed management. - Enhancing coastal resilience. - Increasing human wellbeing. - Decrease in morbidity and mortality rates. 	<ul style="list-style-type: none"> - Gathering and stabilizing sediment. - Reducing low wave energy erosion. - Filtering and improving water quality. - Natural nursery and habitat for various species of fauna. - Increase in biodiversity (indirectly) 	<ul style="list-style-type: none"> - Creation of green jobs. - Facilitate tourism. - Cultural uses. - Educational uses. - Provision of food, medicine, and wood. - Air pollution reduction - Reduction of coastal damages to agriculture, livestock, infrastructure, etc.

	contributes to economic benefits). - Long- and short-term CO ₂ storage.	
--	---	--

2.4 Vulnerability

2.4.1 Vulnerability to climate change

The concept of vulnerability is a multi-dimensional concept that encompasses social, physical, and ecological factors which affect the overall vulnerability of a system (Bevacqua et al., 2018). This has led to different scholars defining it in different ways, with one of the definitions characterizing vulnerability as the physical exposure to various climatological hazardous events and to what extent these affect people and structures. This vulnerability with regards to climate change is determined by a combination of a systems sensitivity and exposure to climate impacts and its structural and social conditions, which constrain access to resources. These aspects of vulnerability are however different depending on the situation and the period in which it has been assessed, indicating its context specificity. (Bevacqua et al., 2018; Nicholls et al., 2008; Smit & Wandel, 2006).

From the above-mentioned theory, it becomes apparent that there is a distinction between types of vulnerability. These are natural or physical vulnerability and socio-economic vulnerability.

Natural coastal vulnerability places emphasis on determining the level of exposure of a location to natural hazards in the physical environment. This type of vulnerability encompasses hazards such as erosion and flooding of recreational, heritage, commercial, and residential properties, impacts on health, education, and employment (Dolan & Walker, 2006). This natural coastal vulnerability is defined as “the degree of incapability to cope with the consequences of climate change and accelerated sea-level rise” (Klein & Nicholls, 1999).

Socio-economic vulnerability on the other hand is determined by the ability of society’s institutional, economic, cultural, and technical sectors to cope with climate-related impacts. Their socio-economic vulnerability is influenced by the present factors within a system such as beliefs and customs, level of political power, age, physical and mental health, and access to resources which differ over time and scales. (Klein & Nicholls, 1999; Bevacqua et al., 2018).

Moreover, it can be derived that the vulnerability of nations and communities to coastal hazards is to a certain extent dependent on the per capita income, making developing countries more susceptible to coastal vulnerability, causing prolonged losses due to social and economic constraints (Bevacqua et al., 2018; Oliver-Smith, 2009). This level of vulnerability can create a vicious cycle in which vulnerability to climate-related hazards increases the lack of capability to deal with and bounce back from these shocks further increasing the system's vulnerability (Laukkonen et al., 2008).

2.4.2 Coastal Vulnerability Suriname

The degree of exposure to coastal vulnerability in Suriname can be attributed to a change of land use from natural mangrove areas to residential settlements, resulting in 76% of the population living in the coastal stretch bordering the Atlantic Ocean (Linnekamp, 2010).

From the socio-economic vulnerability assessment of Paramaribo, it can be derived that this type of vulnerability is not equally distributed within the population, with lower-income neighborhoods and households suffering longer and more from the impacts. The most important impacts include loss of time from school and work due to water-related impediments

and stress from the fear of financial damages stemming from property flooding (Linnekamp et al., 2010).

From the above-mentioned points, it can be derived that the coastal socio-economic vulnerability in Suriname can be measured by the following indicators: the average monthly income within a certain neighborhood, which is relevant for determining whether households can take actions to address their vulnerability to flooding. Secondly, the population density, which is relevant to determine the number of people affected within the area, with a higher population density being more vulnerable than one with a smaller population density. Thirdly, the recreational and social facilities available within the area, this because Paramaribo's poorer neighborhoods which are more susceptible to flooding tend to have fewer recreational or social facilities. Lastly, the level of education which influences the level of awareness regarding flooding and the average monthly income (Linnekamp et al., 2010).

These aspects are separate from the natural vulnerability to sea-level rise that the WnZ area is naturally faced with. The combination of human-induced pressures combined with the categorization of Suriname as a LECZ indicates the high natural vulnerability of the WnZ area. However, to address these vulnerability issues, it is important to not only target the vulnerability aspect with regards to sea-level rise but also focus more broadly on the economic, political, and social inclusion of the more vulnerable populations. This can be achieved by building adaptive capacity within local governments and locals, which enables them to identify solutions regarding these climate-related issues thereby, minimizing future risk or mitigating certain consequences (Nicholls et al., 2008; Oliver-Smith, 2009).

2.5 Adaptive capacity

2.5.1 Climate Change related Adaptive Capacity

Climate change adaptive capacity is the capacity of certain actors, humans, and or institutions within a system to manage or respond to impacts of climate change, while also taking advantage of opportunities (IPCC, 2014; Linnekamp et al., 2010). Adaptive capacity its ability to respond to climate-related issues differs within communities, groups, individuals, and time, due to its context specificity, with changes in political, social, economic, and institutional aspects all affecting the adaptive capacity of an area. From the above mentioned, it can be derived that there's an interrelation between these aspects if assessed from the perspective of a community, in that they can influence each other and the overall adaptive capacity. Furthermore, the level of adaptive capacity derived from these different aspects is indicative of the processes and availability of resources within the economic, institutional, and social sectors within such an area and cannot be seen as isolated aspects within adaptive capacity (Smit & Wandel, 2006).

From the above-mentioned theory, it can be derived that the indicators necessary to determine the level of adaptive capacity include improved availability of resources, human capital, halting land degradation, increasing and restoring ecosystems and biodiversity, increasing accessibility to social capital, availability of relevant institutions, accessibility of technology and the risk perception, diversification of income, increased local participation and awareness of the local community regarding climate change (Dolan & Walker, 2006; Owen, 2020). These indicators aim to reduce the risk of climate impacts, enhancing community well-being and relationships, improving ecosystem health, increasing locals' economic resources, and strengthening institutions (Owen, 2020) and can be enhanced by improving the indicators of the social, institutional, and physical sectors within a system. However, the opposite can be derived from Vohland et al, (2012) stating that climate change is having the inverse effect on adaptive capacity. This, because climate change is increasing the stress within ecosystems thereby, reducing the availability of ES and products to the population, making it harder to adequately adapt to climate change.

The improvement of natural resources and socio-economic development improve the adaptive capacity due to the direct relationship between these two aspects (Laukkomen et al., 2008). These improvements must take place on the local level and must be part of an integrated approach that considers all the above-mentioned indicators, resulting in a greater chance to achieve desirable levels of adaptive capacity (McNamara & Buggy, 2016). These sectors are interrelated with each other all contributing positively or negatively to the total adaptive capacity of a system (Bossio, 2019). However, the measuring of such indicators before their realization within a system can be difficult due to their dormant nature (Engle, 2011).

2.5.2 Coastal Adaptive Capacity

Developing countries and poorer communities lack the capability to adapt accordingly to climate change due to the lack of institutions and resources needed for adequate adaptation, competing or conflicting goals and priorities, and future uncertainty (Owen, 2020). This is worsened by the fact that higher percentages of developing countries their population tend to live within their coastal areas adding the coastal vulnerability aspect to these populations as mentioned in section 2.4. It is possible to increase these poorer communities their adaptive capacity by enhancing their education, health, and food and water security enabling them to reduce their ecosystem degrading activities (Vohland et al., 2012). However, the adaptive capacity of an area is not solely dependent on the availability of resources within an area or country but is dependent on the collective improvement of what is known as the five disciplines of adaptive capacity, which is seen in the figure below.

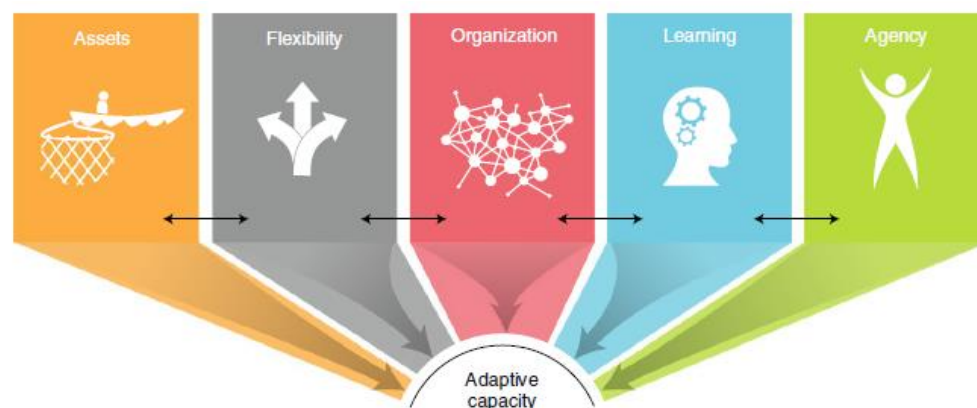


Figure 4: Five disciplines of adaptive capacity. (Cinner et al., 2018)

Assets include the availability and access of populations to finance (affordable capital, credit), technical (technology) and healthcare services. Flexibility, as a part of the adaptive capacity of an area, entails the ability to adjust between adaptation strategies or the capacity to switch between related professions as a response to climate-related impacts (Cinner et al., 2018). Social organization encompasses the social capital within the coastal areas. Social capital can be described as cooperation, sharing of knowledge, and informal relationships by social gatherings, etc, which enables relationships within communities and outside organizations. The formed relationships contribute to the securing and accessing of novel information and resources while aiding locals to voice their opinion. Learning can be seen as organizations and individuals their capacity to generate, absorb and process climate-related adaptation measures over spatial and temporal scales. This enables entities to better understand and anticipate accordingly to the climate-related impacts they are faced with. Lastly, agency can be considered as the ability of organizations or individuals to determine how and if they want to address climate risk (Cinner et al., 2018).

2.6 Relationship between Ecosystem services, Adaptive Capacity, and Vulnerability

NbS and the provided ES can directly or indirectly influence the vulnerability and adaptive capacity of an area in which they are implemented (Vohland et al., 2012). This influence becomes apparent in the fact that NbS its characteristics and its provided ES can influence the social, economic, and environmental sectors of an area in which they are introduced thereby, directly, or indirectly influencing indicators of adaptive capacity (Almenar et al., 2020; Himer-Cornell, 2018; Owen, 2020). These common NbS characteristics and provided ES help increase the availability of assets, flexibility, social organization, learning opportunities, and local agency thereby, contributing to the positive development of adaptive capacity within local populations and areas of implementation. Furthermore, this integrated approach of implementing ES to positively develop adaptive capacity in a multi-sectoral way indirectly addresses especially climate-related socio-economic vulnerability within societies (Vignola et al., 2010).

The relationship between vulnerability and NbS lies within the fact that the multitude of ES derived from NbS implementation can address the socio-economic and natural vulnerability simultaneously. An example being mangrove forests which increase local well-being, provide alternative forms of income, and reduce erosion which reduces the overall vulnerability of the area. Moreover, from theory, it can be extracted that the strongest link between ES and vulnerability is between regulating ES and natural vulnerability with the other ES types having a more indirect link with the concept of vulnerability (Locatelli et al., 2008). However, if the relationship is assessed from the impact that vulnerability has on the ES it becomes apparent that actions that increase mangrove ecosystem vulnerability such as land-use changes, pollution, and overextraction, decrease the potential of NbS to provide ES. This reduction in ES is further worsened by the climate change related pressures, eventually increasing climate-related vulnerability (Locatelli et al., 2008).

The focus now switches to the relationship between the concepts of vulnerability and adaptive capacity. There is a clear intrinsic non-trivial link between the concepts of vulnerability and adaptive capacity, which has also previously been discussed by scholars. These have studied the effects that the reduction of natural vulnerability has on increasing adaptive capacity and how this overlaps (Galoppin, 2006). Recognizing the vulnerability of a system is also a good starting point when assessing strategies for increasing adaptive capacity. This can be noticed from the perspective of vulnerability in which analysis of climate-related impacts such as damage to property and ecosystems, loss of lives and property and how this affects adaptive capacity, allows for indication and identification to be formed about the level of adaptive capacity of an area giving decision-makers the needed insight to facilitate and determine adequate coping strategies (Mcnamara & Buggy, 2017; Dolan & Walker, 2006; Engle, 2011). Furthermore, this effect on vulnerability can also be noticed within the increase in damages to critical infrastructure due to climate change, resulting in the decrease in adaptive capacity (Dolan & Walker, 2006; Engle, 2011). However, this can also be the case from the opposite perspective in which a reduction in adaptive capacity such as in social capital can cause increases in vulnerability, indicating the interlinkage between the concepts. Smit & Wandel, (2006) have built upon this relationship by adding the element of time stating that current vulnerability directly affects current adaptive capacity which determines future adaptive capacity. However, when implementing adaptation strategies that aim to address future adaptation needs, it can be seen that this also positively affects current adaptive capacity, reducing the level of vulnerability of the current system to climate-related issues.

2.7 Conceptual framework

The conceptual framework of this research is illustrated in figure 5. From the above-mentioned literature, it can be derived that the implementation of NbS contributes to a certain amount of ES, which can be categorized into three categories namely: social, economic, and environmental benefits. These three categories have a direct causal effect on the socio-economic and natural vulnerability of the local citizens and the area. However, the adaptive capacity has a moderating effect on the causal relationship, influencing the vulnerability but not the ability of NbS to produce ES.

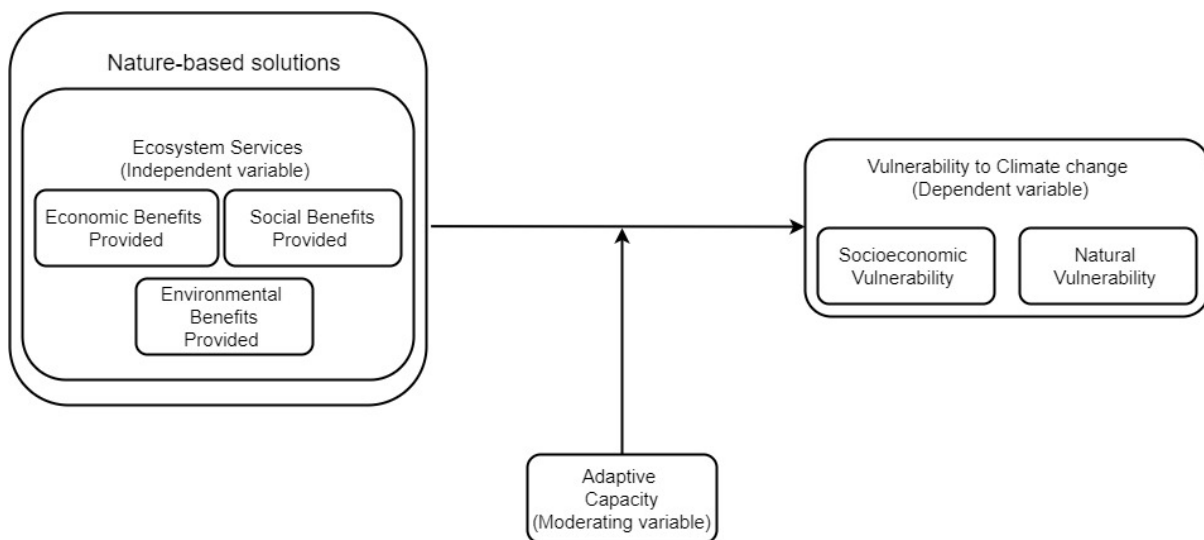


Figure 5: Conceptual Framework

Chapter 3: Research Design and Methods

3.1 Introduction

The research design is an important aspect of the research due to its purpose to clarify the methods used to answer the research questions. This is done within this chapter in which the different phases of the research are discussed, from the research strategy and operationalization to the data collection methods and analysis.

3.2 Research Strategy

The research strategy chosen to guide this research is that of the “single holistic case study”. This choice was made due to the context-specific nature of the study, which focused on the “Building with nature” NbS project and its provided social, economic, and environmental benefits and how these influence the adaptive capacity to address natural/physical and socio-economic vulnerability. It can be derived from the context specificity of the question that the study aims to acquire a knowledgeable understanding of the case while providing more in-depth knowledge regarding the concepts. This results in a more complete explanation of the causal relationships between the different concepts within the case study (Thiel, 2014). This choice is also the most relevant approach due to the small number of units in combination with the larger number of variables being studied in this research (Thiel, 2014). The previously mentioned points contribute to the high internal validity of the research. However, this strategy is not without its shortcomings which encompass the fact that findings cannot be generalized for other cases, resulting in the decrease of the external validity of the study.

3.2.1 Validity and Reliability

The case study approach which was selected as the research strategy does have its challenges regarding the interconnected research criteria of validity and reliability. From Thiel (2014), it can be extracted that validity can be divided into internal validity, which entails the soundness of the study itself, and external validity, which refers to what extent the study can be generalized. Firstly, the study increased the validity by correctly and adequately operationalizing the main concepts and indicators in the context of the WnZ area. Secondly, the research triangulated the data collected by the survey approach by also including other data collection methods such as semi-structured interviews and secondary data collection (Thiel, 2014). These actions eventually helped to establish valid findings regarding the relationships between the concepts.

The study also addresses the reliability aspects of the study, which encompasses the accuracy and consistency of the conducted research (Thiel, 2014). This was done by maintaining a log of the steps taken and the data sources used within the study to ensure the replicability of the study by other researchers. Transparency about the methods, sources, and findings within the study in combination with the honest reporting of deviations further contributes to the reliability.

3.3 Operationalization

In this section, the main concepts within the theoretical and conceptual framework are operationalized, namely the ES provided by NbS, vulnerability both natural/physical and socio-economic, and adaptive capacity. These main concepts are defined in the underlying table and are divided within the relevant variables and their respective measurable indicators. Identifying these indicators will aid in streamlining the data collection and further analysis.

Table 2: Main Concept Definitions

Author	Concept Definitions
Nature-based Solutions	
Almenar et al., 2020, pp. 2	“actions to protect, sustainably manage, and restore (create) natural or modified ecosystems that address societal challenges (including urban ones) effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits.”
ES benefits provided by NbS (Main independent variable)	
Vo et al., 2012	Services provided by ecosystems to humans, which contribute to making human life both possible and worth living. This includes goods such as food crops, seafood, forage, timber, and biomass.
Social Benefits of ES (Sub-independent variable)	
Faivre, 2017	Services provided which address societal challenges increasing resilience to climate-related impacts and increasing human well-being such as urban regeneration and watershed management.
Environmental Benefits of ES (Sub-independent variable)	
Himes-Cornell, 2018	Services which provide the area of environmental benefits such as controlling wave induced erosion and natural nursery capabilities.
Economic Benefits of ES (Sub-independent variable)	
Vo et al., 2012	Economic ES can be seen as a combination of social and environmental benefits which are directly or indirectly enjoyed, used or consumed for human well-being”
Vulnerability (Main dependent variable)	
Bevacqua et al., 2018	the physical exposure to various climatological hazardous events and to what extent these affect people and structures. This vulnerability is the result of structural and social conditions which constrain access to resources.
Natural vulnerability (Sub-dependent variable)	
Klein & Nicholls, 1999	“the degree of incapability to cope with the consequences of climate change and accelerated sea-level rise”
Socio-economic vulnerability (Sub-dependent variable)	
Bevacqua et al., 2018	the ability or inability of society’s institutional, economic, cultural, and technical sectors to cope with climate-related impacts.
Adaptive Capacity (Moderating variable)	
IPCC, 2014	Adaptive capacity with regards to climate change is seen as the ability and the capacity of certain actors, humans and or institutions within a system to manage, or respond to impacts of climate change, while also taking advantage of opportunities.

Table 3: Operationalization

Concept	Variables	Indicators	Data collection method	Data Source	Measurement unit
1: Ecosystem services	1.1: Environmental benefits	1.1.1: Halting of land degradation by gathering and stabilizing sediment.	Semi-structured interview	Project representatives	Narrative measurements.
			Survey	Local citizens	The locals their perception that the project has halted land degradation by gathering and stabilizing sediment using the Likert scale: ranging from strongly disagree to strongly agree, and their perception on the number of meters gained.
		1.1.2: Increase in Biodiversity.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Increase in the variety of plants and animals within the area by the project using the Likert scale: ranging from strongly disagree to strongly agree.
	1.2 Economic benefits	1.2.1: Tourism.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Increase in the number of tourists to the WnZ area using the Likert scale: ranging from strongly disagree to strongly agree.
		1.2.2: Job creation.	Semi-structured interview	Project representatives	Narrative measurements

			Survey	Local citizens	Increase in the number of jobs due to the project using the Likert scale: ranging from strongly disagree to strongly agree.
		1.2.3: Provision of additional food sources.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Addition of new food sources by the project using the Likert scale: ranging from strongly disagree to strongly agree.
		1.2.4: Reduction of coastal damages.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Reduction of coastal damages due to the project using the Likert scale: ranging from strongly disagree to strongly agree.
	1.3: Social benefits	1.3.1: Recreational uses provided.	Survey	Local citizens	Addition of new recreational possibilities in the Wnz area created by the project using the Likert scale: ranging from strongly disagree to strongly agree.
		1.3.2: Cultural and or spiritual services provided and or maintained.	Survey	Local citizens	Creation or maintenance of cultural and spiritual benefits by the project using the Likert scale: ranging from strongly disagree to strongly agree.
		1.3.3 Educational services provided.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Usage of the project for educational purposes regarding the locals and or the university using the Likert scale: ranging from strongly disagree to strongly agree.

		1.3.4: Involvement in NbS projects.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Contribution of locals within the project such as financial contribution, volunteering, promoting, and not contributing to the project.
		1.3.5: Regeneration of mangrove forest.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Increase in the number of mangrove trees by the project within the WnZ area using the Likert scale: ranging from strongly disagree to strongly agree.
2: Adaptive capacity	2.1: Assets	2.1.1: Access to Finance	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Additional forms of income for the local citizens created by the project using the Likert scale: ranging from strongly disagree to strongly agree.
		2.1.2: Enhanced well-being of local citizens	Survey	Local citizens	Perception of the locals that the project has enhanced their well-being by using the Likert scale: ranging from strongly disagree to strongly agree.

	2.2: Flexibility	2.2.1: Flexibility to switch between climate-related strategies.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	The project made it easier for the area to adapt to new strategies and climate situations using the Likert scale: ranging from strongly disagree to strongly agree.
	2.3: Social Organization	2.3.1: Increased local participation and awareness regarding climate change and mangroves.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Locals their willingness to participate in future workshops about climate change and mangroves, their willingness to volunteer and or financially contribute to the project using the Likert scale: not willing to willing.
		2.3.2: Formal and informal cooperation between communities and stakeholders.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	The project has Increased cooperation between the stakeholders of the project using the Likert scale: ranging from strongly disagree to strongly agree.
	2.4: Learning	2.4.1: Access to formal and informal learning	Semi-structured interview	Project representatives	Narrative measurements

		regarding climate change and mangroves.	Survey	Local citizens	Locals receiving information ranging from receiving both formal and informal information or just one of the two or none; and Willingness of locals to share knowledge with other locals regarding flood protection using the Likert scale: ranging from not willing to willing.
	2.5: Agency	2.5.1: Willingness of locals to address climate risk.	Survey	Local citizens	The willingness of locals to address climate-related issues using the Likert scale: ranging from not willing to willing.
3: Vulnerability to climate change	3.1: Socio-economic vulnerability	3.1.1: Average income within the WnZ area.	Survey	Local citizens	Range of net monthly income in Surinamese dollars.
		3.1.2: Presence of recreational and social facilities.	Survey	Local citizens	The number of social and recreational facilities present within the WnZ area.
		3.1.3: Population density.	Secondary data	Statistical national census data	Number of citizens in the area.
			Survey	Local citizens	The number of people per household.
		3.1.4: Level of education.	Survey	Local citizens	Last school graduated from.
	3.2: Natural vulnerability	3.2.1: Level of risk of erosion within the WnZ area.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Locals' perception on the likeliness of erosion occurring in the WnZ area using the

					Likert scale: ranging from very unlikely to very likely.
		3.2.2: Level of risk of flooding within the WnZ area.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Locals' perception on the likeliness of flooding occurring in the WnZ area using the Likert scale: ranging from very unlikely to very likely.
		3.2.3: Level of risk of flooding of commercial properties.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Locals' perception on the likeliness of commercial properties flooding in the WnZ area using the Likert scale: ranging from very unlikely to very likely.
		3.2.4: Risk of flooding of cultural properties.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Locals' perception on the likeliness of cultural properties flooding in the WnZ area using the Likert scale: ranging from very unlikely to very likely.
		3.2.5: Risk of flooding of residential properties.	Semi-structured interview	Project representatives	Narrative measurements
			Survey	Local citizens	Locals' perception on the likeliness of residential properties flooding in the WnZ area using the Likert scale: ranging from very unlikely to very likely.

3.4 Data Collection Methods & Sample Size Selection

3.4.1 Data Collection Methods

This study made use of qualitative data, which encompasses non-numerical, descriptive, or nominal data, and quantitative data, which entails numerical data. This data collected can be categorized as primary data since this data was collected for this study and has not previously been gathered (Kabir, 2016).

The collection of the primary quantitative data was done via the survey data collection method, which encompasses the usage of the questionnaire research instrument. This method assumes that selected sample participants have a personal understanding of the occurrence being studied which enables the collection of information of people their opinions and attitudes regarding those variables studied (Thiel, 2014). The layout of the questionnaire started with an introductory section, followed by the control variables such as age, education, and profession which enable the researcher to specify whether answers are characteristic of certain groups within the population (Thiel, 2014). These were followed by the easier questions which introduce the core questions regarding the variables. The questions consisted of a mix of scoring questions that use the Likert scale and close-ended questions with pre-determined answers, which included the option for adding additional personal answers if pre-determined answers did not include the respondent's preferred answer. Before the questionnaire was sent out it was tested within a pilot study in which shortcomings of the questionnaire were identified, this helped increase the validity and the reliability of the questionnaire. The questionnaire was self-administered online and by an assistant in person for those citizens of WnZ who do not have access to the internet. The questionnaires were made available in Dutch since this is the official language of the country.

Triangulation of the acquired data took place via the implementation of other data gathering methods which included secondary data collection, which was used to acquire area-specific data such as the area of WnZ, density, and relevant coastal characteristics.

Furthermore, the usage of semi-structured interviews enabled the acquiring of more in-depth and specific data regarding the main concepts of the study. The semi-structured interview consisted of an interview guide that included a list of questions and topics relevant to the main concepts of the study and targeted the project representatives of the “Building with nature” project. This enabled the interviewer to go beyond the questions in the interview guide thereby, making additional data collection possible, increasing the understanding of the case study, and improving the findings and answers to the research questions. Before the collection of the data could take place, it was mandatory to receive participants their consent either written, oral or electronic (Bryman, 2012). The privacy of the respondents of the survey was held anonymous by excluding personal details and was stored on safe online platforms such as “SURF”.

3.4.2 Sampling Technique

The population eligible for the study and thereby, the questionnaire were all the locals of the WnZ area bordered in the north by the Atlantic Ocean, in the west by the Kwie Kwie road, in the east by the Washingtonstreet and to the south by the Kwattastreet as indicated in figure 6. The total population within this area is approximately 14000 and with different backgrounds (Cete et al.2018). These borders and population numbers were used within the study since more in-depth neighbourhood data within the Weg naar Zee area is non-existent.

Probability sampling was chosen due to the limited time and funding available for the research and its ability to provide a representative sample of the whole population studied, which enables the generalization of the findings to take place (Thiel, 2014).

The type of probability sampling used was that of simple random sampling in which the whole of the WnZ area was divided within two areas: area 1 which consists of the locals who are most affected by the “Building with nature” project taking place along the coastal area and area 2 which consists out of the locals of the Weg naar Zee area which the project does not affect as much. These areas are divided by the Tiengieholoweg which separates the whole of the WnZ area into a northern and southern part. Due to the lower population density within area 1, sampling took place by randomly selecting every 2nd household within every street within said area. However, for area 2 due to the higher population density and difference in land use which is mostly focused on residential plots the sampling took place by randomly selecting every 5th household within every street within said area.

This approach enabled the collection of a sample of the WnZ area which is representative of the two areas. The spreading of the online versions of the questionnaire was done via email by official local government representatives of the WnZ area. However, due to low initial response rates within the areas, reminder emails were sent combined with in-person administration of the questionnaires, which used the same random selection technique. This was done to increase the number of filled in questionnaires.



Figure 6: Sampling areas (Google maps, 2021).

The calculation of the sample size representative of the WnZ area was done by Slovin’s formula which is most adequate when no behavioral trades of the population are known. The formula is as follows (Ellen,2020):

$$n = \frac{N}{1 + Ne^2}$$

With **n** = sample size
N = population size
e = margin of error

The population within the WnZ area consists of 13832 citizens (Stichting Planbureau Suriname, 2014). The margin of error is the standard error margin of 5% or 0.05 in decimal numbers.

$$n = \frac{13832}{1 + 13832 * (0.05)^2}$$

n = 384

This calculation hence resulted in a sample size of 384 questionnaires. This number of questionnaires was distributed physically within the WnZ area and online by local representatives. However, a total of 165 administered questionnaires were achieved during the data collection period of this study.

Contrary to the questionnaire approach, the semi-structured interview makes use of non – probability sampling solely making use of the snowball sampling approach. The non – probability snowball sampling approach is a method in which the respondents are recommended by previous respondents who have taken part in the study (Thiel, 2014). This snowball sampling started with the person responsible for the initiative of the project which is professor Sieuwnath Naipal. The suggested professionals identified as important to the project were the representatives of the following organizations: The United Nations Development Programme (UNDP), Foundation Forest management and Surveillance (SBB), Conservation International Suriname (CIS), World Wide Fund for Nature (WWF), the local farmers' organization and the initiator. From the above-mentioned organizations, one representative was interviewed resulting in a total of 6 interviews administered as seen in table 4. This approach did not include the local citizens but was aimed at compiling more qualitative expert data, therefore targeting the project representatives responsible for the development, implementation, management, and monitoring.

Table 4: Interviewees table

Code	Organization	Position	Source	Interview Duration
R-1	Anton de Kom University	Initiator of the “Building with nature” project in WnZ	Secondary data	46:46 minutes
R-2	CIS	Development & Communications Manager	Snowball sampling	42:59 minutes
R-3	UNDP	Project manager	Snowball sampling	48:16 minutes
R-4	SBB	Vice-chairwoman research and development department	Snowball sampling	27:34 minutes
R-5	WWF	Oceans and Wildlife officer	Snowball sampling	43:33 minutes
R-6	Farmers organization “Sustainable Weg naar Zee”	Chairman	Snowball sampling	51:24 minutes

3.5 Data Analysis Techniques

The results of the questionnaire were analyzed and recorded using the computer software STATA. This software which is widely used in combination with descriptive statistics aided in the quantitative analysis of the data collected. The analysis within the STATA software was done by conducting the correlation analysis, which gave the possibility to identify the significant positive and or negative correlations between the relevant indicators and aspects that could answer the research questions.

The qualitative data management was done by digitally transcribing the semi-structured interviews within Microsoft word. This was followed by the coding and analysis process which took place in the Atlas.ti software. The analysis of the coded transcribed data was conducted by using the co-occurrence table and query options, which helps identify the relationships, important quotes, and usage of characteristic words. However, this software does not interpret the collected data fully making it necessary to use critical thinking and analytical skills to assess the transcripts to find the interrelations and important features discussed.

3.6 Challenges and Limitations

The challenges and limitations that the study was faced with were related to the collection of questionnaires from the local citizens, with the biggest challenge lying within the response rates. This is especially the case with the online surveys in which two factors influence the response rate, these are the inability to access closed communities and the existence of non-legit surveys, which reduce people their willingness to participate (Thiel, 2014). An added challenge in the context of the WnZ area is the internet accessibility of local citizens which also negatively influenced the response rate. However, this is addressed by combining online surveys with physical surveys. The presence of Covid-19 did negatively influence the response rates of locals to physical surveys, due to the locals their fear of contracting the virus, resulting in more rejections by locals. This was worsened by the partial lockdown and curfew measures taken by the national government, reducing the amount of time available for data collection. The above-mentioned challenges in combination with the time constraint resulted in a limitation of the study, in that 165 out of the targeted 384 questionnaires were achieved. Furthermore, it is not possible to say with a hundred percent certainty that the answers given by the respondents are completely truthful. This is especially the case with the online surveys in which it is also unclear as to how seriously and with how much thought these surveys have been answered in comparison to when these are conducted physically.

Chapter 4: Research Findings

The findings for the variables and indicators of the study will be presented in the structure of the operationalization to adequately answer the sub-questions and main question.

4.1 What social, economic, and environmental benefits does the “Building with nature” (NbS) project contribute to the WnZ area?

4.1.1 Environmental Benefits of the Project

The environmental benefits which will be discussed include the halting of land degradation by gathering and stabilizing sediment and the increase in biodiversity. From the interviews, it is clearly noticed that the project has halted land degradation and increased biodiversity. However, from the questionnaire, it seems that respondents do not feel as strongly about these environmental benefits.

Table 5: Questionnaire results Environmental Benefit indicators.

Indicator	Strongly disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Halting of land degradation by gathering and stabilizing sediment.	4	2.4%	7	4.2%	45	27.3%	64	38.8%	45	27.3%	165	100%
The project has increased the variety of plants and animals.	5	3.0%	7	4.2%	49	29.7%	62	37.6%	42	25.5%	165	100%

A. Halting of land degradation by gathering and stabilizing sediment.

All the interviewees unanimously mention that since the implementation of the project along the coastal area, it is visually noticeable that there has been an increase in sedimentation along the coast; not only halting land degradation but also resulting in land reclamation, stating:

“In 2019 it must have been, it was clear that sedimentation was taking place. Not only because of the mangrove but because of the sediment traps that have been installed a few meters off the coast. You could clearly see that a certain amount of land acquisition was happening” (R-3, 16 July 2021)

From the questionnaire results in table 5, it can be derived that the local population does not have a strong opinion regarding the statement that the project has halted the land degradation taking place along the coast by stabilizing sediment.

B. Increase in biodiversity

The project has also contributed to the increase in biodiversity of the local WnZ region in which all the interviewees have noticed an increase in especially, the number of mangrove trees, the return and increase of the Snipe, the Scarlett Ibis bird species, and an increase in the number of crabs which results from the increase in mangrove trees, stating:

“We also see that mangroves are beginning to grow on their own in certain locations because of a lot of sediment, but the biodiversity is increasing, the fishery sector is also starting to become visible nearby” (R-1, 15 July 2021)

“Of course, with mangrove forests, there is a bit of diversity that goes along with the ecological value of your mangrove, so it certainly has a positive effect on your coastal life and your crabs and the animals that actually live in the mangrove” (R-4, 16 July 2021)

It becomes apparent that these two environmental benefits follow each other in which the STU’s are used to collect sediment which then enables the growth of the mangroves thereby, supporting and increasing the biodiversity.

However, from the questionnaire, it can be derived that the locals again do not have a strong opinion about the statement that the project has increased the biodiversity of the WnZ area with no clear agreement or disagreement with the statement.

4.1.2 Economic Benefits of the Project

The economic benefits highlighted from the “Building with nature” project consist of tourism, job creation, provision of additional food sources, and reduction of coastal damages. The interviewees and the questionnaires do have similar findings in that the project has not noticeably contributed to the economic aspect of the area.

Table 6: Questionnaire results Economic Benefit Indicators.

Indicator	Strongly disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The project has increased the number of tourists	4	2.4%	25	15.2%	85	51.5%	29	17.6%	22	13.3%	165	100%
The project has contributed to the increase in the number of jobs.	8	4.8%	30	18.2%	81	49.1%	27	16.4%	19	11.5%	165	100%
The project has contributed to the addition of new food sources.	3	1.8%	22	13.3%	66	40.0%	49	29.7%	25	15.2%	165	100%
The project has contributed to the reduction of coastal damages.	2	1.2%	9	5.5%	31	18.8%	74	44.8%	49	29.7%	165	100%

A. Tourism

Trainings have been organized by Conservation International Suriname (CIS) in which the locals have been trained in the different aspects of the tourism sector. This training of the locals has not yet resulted in an increase in tourism numbers due to Covid-19. However, there have been tourist visits that mostly occur during mangrove planting events that professor S. Naipal organizes (R-2, 13 July 2021). Furthermore, it can also be concluded that the increase in biodiversity, especially that of bird species within the region has resulted in birdwatchers and ornithologists visiting the area. However, the tourism potential is much higher, with the main selling points being, the closeness to the center of the capital of Suriname, the biodiversity, and that this is the only coastal region of Paramaribo that is easily accessible by car (R-5, 26 July 2021).

“So, it is because, in fact, the only place in Paramaribo where you can see waterfowl. It is the only place accessible to go to the ocean in Paramaribo” (R-5, 26 July 2021).

From table 6 it is noticed that 51.5% of the respondents remain neutral concerning this aspect which corresponds to that of the interviews in which no notable increases have been noticed.

B. Job creation

From the interviews, it can be concluded that the number of jobs has to a small extent been influenced by the project. Most of the jobs made available for the local population are project-based jobs described as hand-labor. These jobs mostly focus on the construction of the STU’s and other project development activities in which hand-labor is needed (R-1, 15 July 2021).

“To a small extent. As I said there are a few people involved in the supply, preparation of materials, planting, making pots for those mangrove plants, maintaining the mangrove plants, and doing maintenance work together with professor Naipal, doing a little bit of monitoring, but I wouldn’t say that it has had a huge impact on the creation of jobs for people from Weg naar Zee.” (R-3, 16 July 2021)

However, as mentioned in the previous section locals have received tourism-related training which is the focus of future job creation within the WnZ area (R-2, 13 July 2021). The involvement of the government has been identified as a crucial aspect that is needed for the upscaling of the project thereby, creating the possibility for dedicated full-time jobs which can be filled in by locals (R-1, 15 July 2021).

From table 6 it can be derived that close to half (49.1%) of the respondents are neutral with the statement that the project has increased the number of jobs, indicating that the locals have mostly not noticed an increase in job availability in the WnZ area since the project only provides periodic jobs.

C. Provision of additional food sources

The WnZ area is known as one of the most productive areas in Paramaribo within the agricultural sector. From the interviews, it can be concluded that the project has not provided additional food sources but has contributed to maintaining the ones present by reducing the coastal erosion taking place thereby, also reducing the risk of flooding (R-6, 23 July 2021).

“... and on the other hand, the dam breaks stop so they don’t have to fear anymore. There will then be no salinization of their areas so that their production will also be better” (R-6, 23 July 2021).

Furthermore, the increase in mangrove trees which can function as the habitat for bees has caused a rise in bee numbers. This increase has resulted in the pollination taking place more quickly than beforehand (R-6, 23 July 2021). However, the full positive potential of the project on the agriculture activities within the area is still to be reached.

From table 6 it can be noticed that it is not clear to the locals whether the project has contributed to the addition of food sources in the WnZ area. With under half of the respondents, 40.0%, remaining neutral.

D. Reduction of coastal damages

The coastal stretch in which the project has halted erosion has a length of 1.5 kilometers. This halting of the erosion is mainly the result of the STU’s in combination with the planting of young mangrove trees which stabilize and hold the acquired sediment in place making further progress into the sea possible (R-1, 15 July 2021). This land acquisition and the planting of the mangroves has also reduced the dam breaches within the area, with the local farmers noticing that dam breaches only still occur in those places where the project has not yet reached (R-6, 23 July 2021).

“It should be clear that for 1.5 kilometers the erosion has stopped, and, in the meantime, we have gained tens of hectares of land, so you have to know that the area was actually hollowed out by erosion, hollowed out by the waves and it just went on. With the “Building with nature” concept and everything else we managed to get this far.” (R-1, 15 July 2021)

From table 6 it can be derived that there is no clear singular opinion regarding the statement that the project has contributed to the reduction of coastal damages. However, it is noticed that under half (44.8%) of the respondents lean towards agreeing with the above-mentioned statement.

4.1.3 Social Benefits of the Project

The social benefits of the project consist of the recreational uses provided, the cultural or spiritual services provided and or maintained, the educational services provided, the involvement of the locals within the NbS, and the effect that the project has had on the regeneration of the mangrove trees within the WnZ area. From the interviews, it becomes

apparent that the project has positively contributed to especially two out of the five indicators. However, from the questionnaire, these benefits are not clearly visible.

Table 7: Questionnaire results Social Benefit Indicators

Indicator	Strongly disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The project has been used for educational purposes regarding the locals and or the university	2	1.2%	3	1.8%	24	14.5%	59	35.8%	77	46.7%	165	100%
	Not contributed to the project		Promoted the project		Volunteered within the project		Financially contributed to the project					
Contribution of the locals to the project.	99	60.0%	35	21.2%	28	17.0%	3	1.8%			165	100%
The project has helped increase the number of mangrove trees.	2	1.2%	7	4.3%	33	20.0%	55	33.3%	68	41.2%	165	100%
The project has contributed to the addition of new recreational possibilities.	9	5.4%	24	14.5%	62	37.6%	42	25.5%	28	17.0%	165	100%
The project has contributed to the creation or maintenance of cultural and spiritual benefits.	8	4.8%	12	7.3%	82	49.7%	36	21.8%	27	16.4%	165	100%

A. Educational Services Provided

From all the interviewees it becomes apparent that the project has provided educational services for the local population and the whole of the country. Due to the easy accessibility and openness of the project, students at the University have used the project to collect data for their research. This is also the case for local schools for which day trips have been organized to visit the project, educating the children on the effects of climate change and the benefits that mangroves have on coastal areas. Furthermore, the findings of the project have also been used to create evidence that can establish this method as proven technology against similar climate-related issues (R-1, 15 July 2021).

“Look, this project is also educational for policymakers because it also indicates that there are other ways than hard infrastructural works to protect the coast. So, in that respect, it is also educational. For the residents, it is educational, it is educational for the general population, and then it is also educational to the volunteers and also the schoolchildren and so on.” (R-5, 26 July 2021)

From table 7 it can be derived that the locals don’t have one clear opinion regarding the statement that the project has contributed educational services to the locals and the university. However, it can be noticed that almost half (46.7%) of the respondents tend to lean towards strongly agreeing with the statement.

B. Involvement in Nature-based solution projects

The involvement of the locals in the project is less than ideal with the involvement being mostly that of temporary hand-labor. The same goes for the planting events organized by the professor. CIS has tried to include more of the locals by organizing awareness programs and trainings. However, this has not produced an increase in the participation levels of the locals (R-2, 13 July 2021). The causes for the lack of local participation seem to be the following; Firstly, due to old government promises to build a dike, some of the locals think that the “Building with nature” project is preventing the government to do so, causing frustration in locals which prefer a quicker solution (R-1, 15 July 2021).

“Some people are just in a hurry. Especially the people who have already lost land or maybe live near the coast or have production areas. They think that the story of “Building with nature” is going a bit too slow and would rather prefer to have a dike the day after tomorrow.” (R-3, 16 July 2021)

Secondly, the financial status of the locals tends to affect their ability to participate in the project. Most of the locals are required to have multiple occupations or subsidiary activities to manage their expenses. Resulting in a reduction of available leisure time to participate (R-6, 23 July 2021).

“People actually have to be paid to do the work. When you are going to count on volunteers, it is difficult to schedule and find willing people.” (R-6, 23 July 2021)

From table 7 it is derived that 60.0% of the respondents have not contributed to the project, solidifying the finding that the locals mostly do not participate in the project.

C. Regeneration of mangrove forest

All the interviewees indicate that the project has had a positive effect on the number of mangrove trees within the area. With one interviewee stating that without the implementation of the project there would not be any mangrove trees present anymore due to the wild nature of the ocean preventing the natural growth of mangroves (R-5, 26 July 2021). The importance of the STU’s ability to trap sediment in combination with the planting of mangrove trees and the presence of bees enable natural rehabilitation to take place, increasing the total number of mangrove trees.

“The sediment traps allow mud to settle, this sedimentation also promotes the natural regeneration. The fact that the beekeeper is there also means that there is probably a higher production of seed material. So going back to the natural regeneration I think the mangrove population and the vegetation have been positively influenced by the sediment traps and by the active planting of young mangroves.” (R-3, 16 July 2021)

From table 7 it is seen that there is not one singular protruding opinion among the respondents regarding the statement that the project has increased the mangrove numbers. However, under half (41.2%) of respondents do lean towards strongly agreeing with the statement.

D. Recreational uses provided

From table 7 it can be derived that the locals do not have a strong opinion regarding the statement that the project has provided or maintained recreational possibilities within the WnZ area.

E. Cultural and or spiritual services provided and or maintained.

The effect that the project has had on the creation and maintenance of cultural and spiritual services is not clear to the locals which is seen in that almost half (49.7%) of the respondents had a neutral opinion with regards to this aspect.

Summary findings

When assessing the indicators of the social, economic, and environmental benefits it becomes clear that the project has not had a noticeable contribution to providing economic benefits according to the questionnaire. However, the interviewees all mention the positive influence on the economic indicators. With regards to the environmental benefits, all the interviewees have noticed a positive contribution to the indicators however, these benefits are not seen as clearly by the locals. Lastly, from the interviews and the questionnaire, it can be concluded that the educational services provided are the most noticeable benefit derived from the project with

all the interviewees agreeing with this combined with almost half of the locals strongly agreeing with this statement.

4.2 What is the current Adaptive Capacity of the Local Citizens of the Weg naar Zee area?

The concept of adaptive capacity consists out of the following five variables: assets, flexibility, social organization, learning, and agency of which the findings will be discussed in the following sections.

4.2.1 Availability of Assets to the Local Citizens of the Weg naar Zee area.

The availability of assets includes access to finance and the enhanced well-being of the local citizens. From the interviews and the questionnaire, it becomes apparent that the project has not noticeably contributed to the availability of assets within the area.

Table 8: Questionnaire results Asset indicators

Indicator	Strongly disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The project has contributed to additional forms of income.	7	4.3%	22	13.3%	99	60.0%	23	13.9%	14	8.5%	165	100%
The project has increased the well-being of the local citizens of the WnZ area.	3	1.8%	16	9.7%	60	36.4%	58	35.1%	28	17.0%	165	100%

A. Access to finance

From all the interviews it can be extracted that the project has had minimal influence on the creation of additional forms of income for the locals. However, income possibilities have been added in the fishery sector which has re-emerged in the area due to the increase in biodiversity. The plan for the near future is to let the locals create the young saplings and sell those to the project. However, a weak point has been identified which is the lack of active government support. The government is also not applying for funds which are made available for similar mitigative and adaptive projects by international funds such as the Paris agreement (R-1, 15 July 2021).

“We’ve already mapped it (the benefits of the project) out, but the government has to accept it, and sometimes they don’t. That’s the problem because then jobs could come because this is self-sufficient, and I repeat this is self-sufficient. The CO₂ you can sell, you can sell the fish, you can develop ecotourism, you get honey out of it, you can have new land, so I don’t understand what the government doesn’t see.” (R-1, 15 July 2021)

This lack of impact that the project has had on adding forms of income is also noticeable from the questionnaire with the majority (60.0%) remaining neutral to the statement that the project has contributed to additional forms of income.

B. Well-being of local Citizens

The influence that the project has had on the well-being of the local population is solely derived from the questionnaire taken from the locals due to the personal nature of well-being. From table 8 it can be derived that the locals are not strongly opinionated about the statement that the project has increased well-being.

4.2.2 Flexibility of the Weg naar Zee area.

From the findings from the questionnaire and interviews, it can be derived that the project has not yet contributed to the increase in flexibility of the area to switch between climate-related strategies. Although, 41.2% of the respondents have agreed with the statement.

A. Flexibility to switch between climate-related strategies

Table 9: Questionnaire results Flexibility indicator

Indicator	Strongly disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The project has made it easier for the area to adapt to new strategies and climate situations.	2	1.2%	14	8.5%	60	36.4%	68	41.2%	21	12.7%	165	100%

The “Building with nature” project is the first official climate strategy implemented within the area to address the erosion and flooding issues. From the interviews, it can be concluded that for the near future the project has established a solid basis for the implementation of Green-grey infrastructure, which is seen as the logical backup strategy if the “Building with nature” project does not bring forward the needed results in time (R-2, 13 July 2021). The project has also contributed to the re-establishment of resources which were gone or threatened to be extinguished, thereby, guaranteeing the availability of those resources for future generations (R-1, 15 July 2021). Contradictory to this is the fact that the project has not yet created a solid basis regarding some necessary economic and social aspects thereby, not increasing the flexibility of the area (R-3, 16 July 2021).

“Both governments and nature and environmental people can then find each other because then you have Green, those are the environmental people and Grey those are the governmental people etcetera. That combination is very important, and I think that will be the future” (R-2, 13 July 2021)

This belief that the project has increased the flexibility of the area to adjust to different climate-related strategies and climate situations is not shared by the locals in that no individual response stands out from the questionnaire with only, under half (41.2%) of the respondents agreeing with this statement.

4.2.3 Social Organization contributed by the Project to the Weg naar Zee area.

The social organization consists of increased local participation and awareness regarding climate change and mangroves and formal and informal cooperation. The results from the questionnaire and interviews point out that the project has not increased the participation of the locals. However, when assessing the awareness and cooperation indicators it is noticed that the questionnaire and the interviews contradict each other with the interviewees noticing positive effects while the questionnaire indicates no significant change with regards to those indicators.

Table 10: Questionnaire results Social organization indicators

Indicator	Not willing		Somewhat not willing		Undecided		Somewhat willing		Willing		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Participate in future workshops about climate change and mangroves.	4	2.4%	20	12.1%	54	32.7%	60	36.4%	27	16.4%	165	100%
Volunteer in the project.	3	1.8%	15	9.1%	64	38.8%	63	38.2%	20	12.1%	165	100%

Financially contribute to the project.	11	6.7%	19	11.5%	81	49.1%	46	27.9%	8	4.8%	165	100%
Indicator	Strongly disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The project has increased the cooperation between the stakeholders of the project.	3	1.8%	8	4.9%	83	50.3%	49	29.7%	22	13.3%	165	100%

A. Local participation and awareness regarding climate change and mangroves.

The awareness regarding climate change and mangroves has been created by organizing different events which targeted different groups within society such as the event organized by the UNDP, which sensitized the media and helped reach a nationwide audience regarding the two topics. On a smaller scale, planting events have been held which resulted in social media attention by posts and photos shared by the volunteers (R-3, 16 July 2021). On a local level, the creation of awareness is mostly focused on children with schools organizing educational trips. It has been concluded that the local population has a high awareness regarding climate change and the benefits of mangroves (R-5, 16 July 2021).

“Weg naar Zee is a place in Suriname where people are really actively struggling with climate change. Weg naar Zee is one of the places I would say if you were to ask, “Where in Suriname do you notice that climate change is intense?” It would be that place. By demonstrating it and physically working on things and not just talking about it, I think you create awareness about mangroves and climate change in that way. I especially like that it’s not just talking, but being more concretely busy” (R-5, 16 July 2021)

However, contradictory to awareness there is a lack of local participation in the project. This is noticed in the trainings and planting events organized by CIS and the professor in which only a small group of locals seem to be interested. This lack of participation of the locals has been identified by the interviewees as the lack of time due to additional work-related activities to increase their financial stability and the passive nature of the locals (R-6, 23 July 2021).

“I do think that the awareness is there, especially those who experience it up close, but yes, there is another factor. The people of Weg naar Zee are people whose nature may be a little different from other neighborhoods and environments, a little bit more passive.” (R-6, 23 July 2021)

From table 10 it can be derived that locals do not have a clear willingness to participate in future workshops about climate change and mangroves. This unclear willingness to participate is further seen in the results of the willingness of locals to participate in the project and also in their willingness to financially contribute to the project with almost half (49.1%) remaining neutral within this last indicator.

B. Formal and informal cooperation between communities and stakeholders.

Most of the cooperation between the different stakeholders is between CIS and professor Naipal since CIS is responsible for finding external funds to guarantee the continuation of the project (R-2, 13 July 2021). However, there is cooperation between the WWF, UNDP, CIS, SBB, and professor Naipal, via the organization Mangrove Forum Suriname (MAFOSUR). The purpose of MAFOSUR is to initiate projects related to mangroves thereby aiming to sustainably manage, protect, promote, conserve, rehabilitate and expand the mangrove areas and mangrove ecosystems in Suriname. Furthermore, the cooperation with the national government is non-existent, while the cooperation with the locals is at a minimum (R-1, 15

July 2021). First steps have been made by the UNDP to cooperate more with the locals in which local farmers and beekeepers have received training to improve their techniques of agriculture production, thereby enabling them to produce saplings for the project (R-3, 16 July 2021).

“In 2019 there was capacity building for farmers and beekeepers in the context of climate change and adaptation, improving techniques for agricultural production and to be more resilient to climate change effects such as drought, heavy precipitation, and intrusion of saltwater.” (R-3, 16 July 2021)

This lack of cooperation with the locals is made clear in table 10, in which the majority 50.3% of the respondents are neutral about the influence the project has had on the cooperation of stakeholders.

4.2.4 Level of Learning with regards to Climate Change taking place within the Weg naar Zee area.

The learning variable contains access to formal and informal learning indicators. The interviews indicate that the level of learning is quite high with multiple ways of learning occurring. However, from the questionnaire, this finding is not as clear.

Table 11: Questionnaire results Learning indicators

Indicator	Not willing		Somewhat not willing		Undecided		Somewhat willing		Willing		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Share knowledge with other local citizens regarding flood protection	4	2.4%	3	1.8%	30	18.2%	70	42.4%	58	35.2%	165	100%
	Formal		Informal		Both Formal and Informal		Not received information					
Received information regarding the project since the start.	23	13.9%	36	21.8%	50	30.3%	56	34.0%			165	100%

A. Access to formal and informal learning regarding climate change and mangroves.

From the perspective of formal learning, it can be derived that a wide variety of workshops and trainings have been organized by the different organizations involved. CIS its focus before the Covid-19 outbreak was on the local citizens and the development of tourism while also introducing the concept of sustainable fisheries. CIS focussed on educating children by teaching them about tourism, the importance of biodiversity and mangroves, and how these can contribute to coastal protection (R-2, 13 July 2021). The UNDP focussed on the capacity building of local farmers and beekeepers concerning climate change adaptation to increase their output. SBB and WWF have used the project as a physical example of how mangroves work to protect coastal areas (R-3, 16 July 2021).

From the perspective of informal learning, it is noticed that the openness of the project to everyone has enabled citizens to experience the effects of climate change and the benefits of mangroves. The informal sharing of knowledge also takes place when the professor organizes mangrove planting events and when schools visit the project enabling the professor to educate the visitors.

“Many educational outings were organized through the schools. I know of my daughter who went there. They can physically see and experience it. It has a positive effect and then they can see it for themselves. They can do that with professor Naipal’s project. Let me say they can

experience the environment up close and that they become aware of “Hey, what does this actually mean for us as residents” they notice how important it is.” (R-6, 23 July 2021)

Table 11 indicates that most respondents have received some form of information regarding the project with 34.0% not receiving any form of information. Furthermore, the locals do not have one strong opinion about their willingness to share knowledge among themselves regarding flood protection. However, under half (42.4%) lean towards somewhat willing to share.

4.2.5 Level of Agency taking place within the Weg naar Zee area due to the “Building with nature” project.

Table 12: Questionnaire results Level of Agency indicator

Indicator	Not willing		Somewhat not willing		Undecided		Somewhat willing		Willing		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Willingness of locals to address climate related issues	2	1.2%	3	1.8%	39	23.7%	55	33.3%	66	40.0%	165	100%

A. Willingness to address Climate-related Issues.

Again, the results from the questionnaire point out that there is no strong opinion regarding the locals their willingness to address climate-related issues.

Summary findings

When assessing the current adaptive capacity from the questionnaire and the interviews it can be derived that the project has not contributed significantly to the current adaptive capacity variables such as the availability of assets, flexibility, and agency. However, when assessing the variables of social organization and learning it can be concluded from the interviews that these have been increased by the project. However, this result has not transferred to the questionnaire results with locals remaining neutral to these indicators.

4.3 What is the level of socio-economic and natural vulnerability of the local citizens of the WnZ area?

4.3.1 Socio-economic Vulnerability of the Local Citizens to Climate Change.

The socio-economic vulnerability consists of the average income, population density, presence of recreational and social facilities, and level of education indicators. From the questionnaire, it can be derived that the WnZ area does not have a high socio-economic vulnerability concerning the indicators.

A. Average Income

From table 13 it can be derived that the option with the highest percentage of responses (26.7%) is that of no response, indicating the unwillingness of locals to share their income details. However, the option with the second-highest percentage (15.8%) is that of more than SRD 8000,- which is the highest possible income option.

Table 13: Questionnaire results Average income.

	Frequency	Percentage
Less than SRD 1000,-	9	5.5%
SRD 1001,- - SRD 2000,-	20	12.1%
SRD 2001,- - SRD 3000,-	11	6.7%
SRD 3001,- - SRD 4000,-	20	12.1%
SRD 4001,- - SRD 5000,-	19	11.5%
SRD 5001,- - SRD 6000,-	8	4.8%
SRD 6001,- - SRD 7000,-	6	3.6%
SRD 7001,- - SRD 8000,-	2	1.2%
More than SRD 8000,-	26	15.8%
No Answer	44	26.7%
Total	165	100%

B. Population density

With regards to the population density, it can be concluded from table 14 that the option with the highest percentage (27.9%) is that of the household size of 4 people, which is approximately the same as the average household size for households within the capital which is 4.1 people per household (General Bureau of statistics, 2016).

Table 14: Questionnaire results Population density.

	Frequency	Percentage
1 Person	8	4.8%
2 People	22	13.3%
3 People	45	27.3%
4 People	46	27.9%
5 People	29	17.6%
6 People	9	5.5%
7 People	4	2.4%
8 People	1	0.6%
9 People	0	0.0%
Equal or more than 10 people	1	0.6%
Total	165	100%

C. Presence of recreational and social facilities

From table 15 it can be concluded that most of the locals 57.0% believe that there are between 1-5 social and or recreational facilities present within the WnZ region.

Table 15: Questionnaire results Recreational and social facilities.

1 – 5 social/ recreational facilities		6 – 10 social/ recreational facilities		11– 15 social/ recreational facilities		More than 15 social/ recreational facilities		No social/ recreational facilities		Total	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
94	57.0%	28	17.0%	8	4.8%	7	4.2%	28	17.0%	165	100%

D. Level of education

From the results of the questionnaire in table 16, it can be derived that most respondents 54.6% have a university education or equivalent.

Table 16: Questionnaire results Level of education.

Primary school education or equivalent		Secondary school education or equivalent		High school education or equivalent		University education or equivalent		Trainings only		Total	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
4	2.4%	16	9.7%	54	32.7%	90	54.6%	1	0.6%	165	100%

4.3.2 Natural Vulnerability of the Local Citizens to Climate Change.

The natural vulnerability consists of the level of risk of erosion and the level of risk of flooding of commercial, cultural, and residential properties. From the findings, it can be concluded that the questionnaire does not support the findings from the interviews, with the interviews indicating high levels of natural vulnerability, while the questionnaires indicate that the likeliness of flooding is not perceived by the locals.

Table 17: Questionnaire results Natural Vulnerability indicators

Indicator	Very unlikely		Unlikely		Average		Likely		Very likely		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The likeliness of erosion occurring in the WnZ area.	4	2.4%	15	9.1%	66	40.0%	34	20.6%	46	27.9%	165	100%
The likeliness of flooding occurring in the WnZ area.	5	3.0%	16	9.7%	48	29.1%	48	29.1%	48	29.1%	165	100%
The likeliness of commercial properties flooding.	6	3.6%	28	17.0%	57	34.6%	38	23.0%	36	21.8%	165	100%
The likeliness of cultural properties flooding.	4	2.4%	26	15.8%	49	29.7%	42	25.4%	44	26.7%	165	100%
The likeliness of residential properties flooding.	5	3.0%	20	12.1%	43	26.1%	51	30.9%	46	27.9%	165	100%

A. Level of risk of erosion within the Weg naar Zee area.

The level of erosion of the WnZ area is seen as very high due to the scientific evidence-based around Suriname's categorization as a LECZ which is supported by the personal experiences of all the interviewees. It can be derived that human intervention and the removal of mangrove trees along the coastal area have caused excessive erosion to occur, which has resulted in the government advising local residents to move out of the area (R-2, 13 July 2021). The erosion occurring is resulting in salt intrusion via the underground, which is mostly affecting the agricultural properties. Furthermore, clay dam breaks are occurring due to erosion. However, the implementation of the project has reduced the total erosion occurring in the area, which is noticeable in that dam breaks that currently still occur are taking place in the areas which have not yet been rehabilitated (R-6, 23 July 2021).

"If you don't do anything there and just continue, business as usual then the catastrophe is just guaranteed. Already dams are breaking, these are earth dams that defend against the sea. Mangroves are also in fact, being knocked over. The mangrove belt has in fact become very thin, these are all conditions that cause the mangrove trees to die, so that is a very big problem" (R-1, 15 July 2021)

"In areas where that (the removal of mangroves) has not happened you see a balanced erosion so to speak, not so terrible that people have to leave, but in that area it did and that is due to human intervention in the past, due to human actions" (R-2, 13 July 2021)

From the questionnaire results in table 17, it is noticed that the respondents are not strongly opinionated about one particular response indicating that they do not have a clear image about the likeliness of erosion occurring as only under half (40%) of the respondents specified average chance of erosion.

B. Level of risk of flooding within the Weg naar Zee area

From all the interviews it can be derived that the level of risk of flooding of the WnZ area has also been categorized as very high, which is caused by a wide variety of issues taking place with regards to that of flooding. As previously mentioned, dam breaks and dike breaks are a reoccurring event within the coastal area of WnZ which causes flooding to occur. Furthermore, the increased intensity and duration of precipitation due to climate change in combination with the low natural elevation of the area is also causing the area to be prone to surface water flooding. Lastly, it can be concluded that flooding which occurs due to springtide causes the most damage in which earth dams and dikes are washed away by the sea worsening the intrusion of saltwater in commercial, residential, and cultural properties (R-3, 16 July 2021).

“It (level of risk of flooding) is very high because at least for several years there have been regular dam breaks and seawater infiltration. There is a Pilgrimage right there along the coast that has also suffered damage from high water levels and high waves and flooding in that area. Some farmers are still regularly losing production due to salt intrusion in the soil, but also simply because of seawater intrusion along the surface, so I think the Weg naar Zee area is very vulnerable from an economic, social, and cultural perspective.” (R-3, 16 July 2021)

The results in table 17 indicate that similar to that of the level of risk of erosion locals do not have one clear opinion about the level of risk of flooding in general indicating that they do not see the likelihood of flooding occurring in the area. These findings remain the same if specifying the likelihood of flooding of commercial, cultural, and residential properties.

Summary findings

The results of the questionnaire point out that the level of socio-economic vulnerability of the WnZ area is being influenced differently by different indicators. The increase of the socio-economic vulnerability occurs due to the low number of social and or recreational facilities in the area with 57.0% of the respondents indicating that there are between 1-5 social/recreational facilities. However, the education level of the locals is reducing the socio-economic vulnerability, with 54.6% of the respondents having a university-level education or equivalent.

When assessing the natural vulnerability of the WnZ area to erosion and flooding it becomes clear from the interviews that this is perceived as being very high. However, the questionnaire points out that the locals do not fully perceive this vulnerability.

4.4 In what way do the social, economic, and environmental benefits of “Building with nature” (NbS) project influence the adaptive capacity of the local citizens of the Weg naar Zee area in addressing climate-related socio-economic and natural vulnerability?

4.4.1 Social, Economic, and Environmental benefits their influence on the Adaptive Capacity.

For defining the correlation strengths between different variables and indicators the Pearson’s correlation coefficient (r) strength categories will be used, which are the following: Very weak (+/- 0 – 0.19), Weak (+/- 0.2 – 0.39), Moderate (+/- 0.4 – 0.59), Strong (+/- 0.6 – 0.79), Very strong (+/- 0.8 – 1.0) (Liang et al., 2019).

Statistical analysis

The correlation results from annex 2 table 1 indicate that the strongest relationship is between access to finance and provision of additional food sources in that it is the only strong significant correlation of +0.606. Furthermore, most of the moderate correlations seem to be between the adaptive capacity indicators of access to finance, enhanced wellbeing of local citizens, flexibility to switch between climate-related strategies, and (in)formal cooperation between communities and stakeholders. Within these categories, the highest moderate correlations are between access to finance and tourism +0.577, enhanced wellbeing of local citizens and reduction of coastal damages +0.538, flexibility to switch between climate-related strategies, and regeneration of mangrove forest +0.551, and formal and informal cooperation and regeneration of mangrove forest +0.522. These results indicate that within the project the ecosystem services of especially tourism, reduction of coastal damages, and regeneration of mangrove forest moderately influence the four above-mentioned adaptive capacity indicators.

Qualitative analysis

Table 18 has been used to assess the relationship between ecosystem services and adaptive capacity, in which it becomes visible that the educational services provided by the project do have a leading role with regards to the influence on the adaptive capacity, especially on the indicators of access to (in)formal learning and the increase on the local participation and awareness regarding climate change and mangroves. This is seen in that the project has made it possible to facilitate different workshops and trainings for the locals by different official organizations such as CIS and UNDP. Furthermore, due to the organization of planting activities and the openness of the project to everyone, knowledge is shared regarding mangroves and the positive effects that it has against climate change. This is mostly done informally by physically contributing or by the knowledge shared by the professor during visits or activities. These forms of educational services provided have resulted in the creation of awareness among the locals. However, no significant influence was noticed in the participation of the locals (R-2, 13 July 2021). Lastly, when zooming in on the relationship between job creation and access to finance it can be derived that the project has contributed to periodic jobs within the project contributing to periodic forms of income for the locals. Future plans of the project do strive to create more permanent jobs for the locals within different sectors, especially within the tourism sector enabling other forms of income (R-1, 15 July 2021).

” Because the professor is working there, it has become a kind of hotspot, so if people think about activities or they want to see how climate change behaves, the negative effects, then that’s the place to look. Everyone says I’ve gone to Weg naar Zee once, you can see it with your eyes, but for a better understanding of what climate change is, Weg naar Zee is ideal it’s

close to the sea, it's one of the few areas where you can see the sea immediately, the coastal influences that water has on the coast" (R-2, 13 July 2021)

Table 18: Co-Occurrence Ecosystem Services and Adaptive Capacity

	Adaptive Capacity	Access to Finance	Access to formal and informal Learning regarding climate change and mangroves	Flexibility to switch between climate-related strategies	(In)formal cooperation between communities and stakeholders	Increased local participation and awareness regarding climate change and mangroves
Ecosystem Services						
Educational services provided		3	28	8	5	16
Halting of land degradation by gathering and stabilizing sediment		2	1	2	0	0
Increase in Biodiversity		5	3	0	1	1
Involvement in NbS projects		3	4	0	6	10
Job creation		11	4	0	3	1
Provision of additional food sources		3	0	0	0	0
Reduction of coastal damages		0	1	1	0	0
Regeneration of mangrove forest		6	1	3	2	0
Tourism		6	6	0	2	3

4.4.2 Adaptive Capacity its influence on socio-economic and natural vulnerability.

Statistical analysis

When analyzing the questionnaire results seen in annex 2 table 2, it can be derived that there are weak to very weak correlations between the adaptive capacity indicators and the natural vulnerability indicators. It can further be concluded that all these weak correlations are positive and significant.

The socio-economic vulnerability was not measured within the interviews due to the personal nature of the indicators. From the questionnaire results, it can be noticed that there is no significant difference in the relationship between adaptive capacity and natural vulnerability and adaptive capacity and socio-economic vulnerability, with all the correlations ranging from weak to very weak. As in the previous relationship, it is noticed that these weak correlations are positive and significant.

Qualitative analysis

From table 19 it can be derived that no co-occurrences are found between adaptive capacity and natural vulnerability.

Table 19: Co-occurrence Natural Vulnerability and Adaptive Capacity

Natural Vulnerability	Adaptive Capacity	Access to Finance	Access to formal and informal Learning regarding climate change and mangroves	Flexibility to switch between climate-related strategies	(In)formal cooperation between communities and stakeholders	Increased local participation and awareness regarding climate change and mangroves
Level of risk of erosion within the WnZ area		0	0	0	0	0
Level of risk of flooding within the WnZ area		0	0	0	0	0
Level of risk of flooding of commercial properties		0	0	0	0	0
Risk of flooding of cultural properties		0	0	0	0	0
Risk of flooding of residential properties		0	0	0	0	0

4.4.3 Social, Economic, and Environmental benefits their influence on the socio-economic and natural vulnerability

Statistical analysis

It can be extracted from annex 2 table 3 that the relationships between the ES and the aspects of socio-economic vulnerability have very weak correlation strengths. When assessing the concepts of ecosystem services and natural vulnerability, it is noticed that the correlation ranges from weak to very weak correlation strengths, with the weak correlations being positive and significant.

Qualitative analysis

The socio-economic vulnerability was not included in the interviews due to the personal nature of the indicators to the locals. However, when using the co-occurrence table 20 to assess the influence that the social, economic, and environmental benefits have on the natural vulnerability, it can be derived that halting of land degradation by gathering and stabilizing sediment co-occurs with that of the level of risk of erosion and level of risk of flooding within the WnZ area. This occurrence of this relationship is a logical relationship since the halting of land degradation is caused by the STU’s implemented within the area. The gathering and stabilizing of said gained sediment reduce the amount of erosion taking place, which directly affects the amount of dam and dike breaks taking place thereby, reducing the occurrence of flooding events. The relationship between the regeneration of the mangrove forest with that of the reduction in flooding is noticed in that mangroves are used for the stabilization of the gathered sediment by the STU’s. Furthermore, the mangroves tend to reduce the wave intensity with regards to strength and height which reduces the chance of floods occurring.

“For the part between the pilgrimage site and the cremation site, where it actually started (the dam breaks) first. Lately, we notice that there is no dam breach in that area, and we see that in that part mangroves have started growing there.” (R-6, 23 July 2021)

Table 20: Co-occurrence Natural Vulnerability and Ecosystem Services

	Ecosystem Services					
Natural Vulnerability		Educational services provide	Halting of land degradation by gathering and stabilizing sediment	Increase in Biodiversity	Reduction of coastal damages	Regeneration of mangrove forest
Level of risk of erosion within the WnZ area		1	4	0	1	1
Level of risk of flooding within the WnZ area		0	3	1	0	3
Level of risk of flooding of commercial properties		1	0	0	0	0
Risk of flooding of cultural properties		0	0	0	0	1
Risk of flooding of residential properties		0	1	0	0	0

From the above-mentioned results, it can be derived that the most important ES provided by the project is that of its educational services provided, which influence multiple adaptive capacity indicators, especially that of access to informal and formal learning and increased local participation and awareness regarding climate change and mangroves. Furthermore, it can be derived that the ES also moderately influence especially the adaptive capacity indicators of access to finance, enhanced wellbeing of local citizens, flexibility to switch between climate-related strategies, and (in)formal cooperation between communities and stakeholders. Contributing moderately to the increase of the adaptive capacity of the locals. The adaptive capacity indicators of the locals however tend to have very weak or weak correlations with the natural vulnerability indicators. However, the weak correlations are positive and significant. These findings are similar to that of the correlations between the adaptive capacity indicators and the socio-economic vulnerability in which all correlations are either weak or very weak. However, the weak correlations are also positive and significant. These results indicate that the adaptive capacity does address the vulnerability concept however, very weak. Moreover, when assessing the relationship between the ES and vulnerability it is noticed that the ES can directly influence the natural vulnerability of the WnZ area. However, this relationship can also be categorized as weak.

Chapter 5: Conclusions and recommendations

5.1 Conclusion

5.1.1 Sub-Research Question 1: What is the level of socio-economic and natural coastal vulnerability of the local citizens of the WnZ area?

The locals of the WnZ area do not have high socio-economic vulnerability. This is seen from the questionnaire in that most of the locals live above the highest poverty line of \$5.50 per day per person (Aguilar et al., 2021) which is the equivalent of SRD 3598,- per person per month. This result is contradictory to that described in Bevacqua et al., (2018) and Oliver-Smith, (2009) in that lack of income plays a pivotal role in the vulnerability in developing countries making them more susceptible to coastal vulnerability. The local population is also not as vulnerable to other socio-economic indicators derived from Linnekamp et al., (2010) such as population density, and level of education. This because the population density average of 3.7 people per household is below the city's household average of 4.1 (General Bureau of Statistics, 2016), which makes the WnZ area less vulnerable to flooding than for example a more highly populated area. Secondly, the fact that most of the locals have received at least a high school level education, reduces the locals their socio-economic vulnerability. However, contradictory to this are the findings that there are not many recreational and social facilities present within the WnZ area, which does increase the socio-economic vulnerability of the locals.

When assessing the natural vulnerability of the area it becomes clear that all interviewees are of the opinion that the WnZ area is highly vulnerable to coastal erosion. However, this opinion is not shared within the local community with under half of the locals (40.0%) believing that the erosion can be seen as average, while no clear opinion is present about the likeliness of flooding. This perception of the locals can be due to the gradual and relatively slow process of coastal erosion or due to the positive results that the project has had on halting land degradation and reducing dam and dike breaks. Furthermore, this difference in derived opinions remains the same when specifying the natural vulnerability of the different property uses of commercial, cultural, and residential.

From the interviews, it can be concluded that the WnZ area its most vulnerable aspect lies within the natural vulnerability, which does not deviate from theory in that WnZ is the most vulnerable area in South America and the Caribbean affected by a 1-meter sea-level rise (Conservation International, 2021). However, from table 17 it is seen that the locals do not perceive this likelihood of erosion and flooding.

5.1.2 Sub-Research Question 2: What is the current adaptive capacity of the local citizens of the WnZ area?

From the results derived from the questionnaire, it can be noticed that the locals have a neutral opinion regarding the two indicators of access to finance and increased cooperation between stakeholders of the project, indicating that the project has had no significant contribution to these adaptive capacity indicators. From the perspective of the interviews, it can be derived that the interviewees support the fact that the project has not contributed to the additional forms of income. However, the opposite result is found in the interviews regarding the cooperation of stakeholders in which all the interviewees indicate an increase in cooperation. This is due to the establishment of the organization MAFOSUR, in which the organizations of the interviewees are represented. Furthermore, from the results of the other indicators of adaptive capacity, it can be derived that there are discrepancies in certain findings when comparing those derived from the interviews, with the questionnaires. With the interviews stating that the project has contributed to the increase of flexibility, local awareness, and access to formal and informal

learning thus contradicting the questionnaire results that the project has not contributed clearly to the building of adaptive capacity within the area, supporting the theory described in Bossio, (2019) and Smit & Wandel, (2006). This theory describes adaptive capacity as different sectors which are interrelated and to achieve preferred levels of adaptive capacity an integrated approach is needed. This is currently missing in the project, which can be noticed in the lack of impact on the adaptive capacity of the local citizens of the WnZ area.

5.1.3 Sub-Research Question 3: What social, economic, and environmental benefits does the “Building with nature” (NbS) project contribute to the WnZ area?

The interviewees unanimously agree that the project has contributed well to both environmental benefit indicators, which encompass the halting of land degradation and the increase of biodiversity in the WnZ area. These results are on par with the literature of Himes – Cornell, (2018) and Toornman et al, (2018) in which it is highlighted that mangroves possess the unique feature of stabilizing sediment while, controlling low wave energy erosion and have a positive effect on the increase in biodiversity of especially bird and fish species. However, when assessing the questionnaire results it can be concluded that this opinion is not shared by the locals with no specific opinion coming to the forefront.

The strongest social contribution has been that of educational services provided in which all of the interviewees mention the positive contribution of the project to the area, which is supported by the fact that under half (46.7%) strongly agree with this contribution of the project. From the remaining indicators of the questionnaire, it is noticed that the project has not contributed to the remaining social benefit indicators derived from Gandhi and Jones, (2019). This lack of impact is highlighted by the result that 60.0% of the locals have not contributed to the project. Furthermore, the lack of contribution to the creation or maintenance of cultural and spiritual benefits is also noticed, with most of the respondents remaining neutral to this aspect. This lack of involvement is supported by the interview results in that the locals their participation is less than ideal, which can be the result of locals their lack of leisure time and preference for a concrete dike.

Furthermore, from Vo et al, (2012) it can be concluded that to achieve economic benefits from mangrove ecosystems, it is necessary for the environmental benefits to work in tandem with the social benefits. From the questionnaire it can be derived that the project does not noticeably contribute to the environmental and social aspects, resulting in the project not contributing to the economical side of things. This is seen in both the interviews and questionnaire in that no notable progress has been identified within the categories of tourism, job availability, and the addition of food sources. However, the project's most noticeable contribution to the economical side is that it has reduced the occurrence of coastal damages such as erosion, dam breaches, and salinization of grounds.

5.1.4 Main Research Question: In what way do the social, economic, and environmental benefits of the “Building with nature” (NbS) project influence the adaptive capacity of the local citizens of the Weg naar Zee (WnZ) area, Suriname in addressing climate-related socio-economic and natural vulnerability?

The analysis of both the quantitative and the qualitative data points out that the social, economic, and environmental benefits of the project do influence the adaptive capacity of the WnZ area. When zooming in on the indicators within these concepts one of the most important ES derived from the interviews is that of educational services provided which influences mostly the access to formal and informal learning and the increased local participation and awareness. This overlapping connection between the two adaptive capacity indicators further solidifies that of Bossio (2019), which describes the different sectors of adaptive capacity as closely interrelated sectors. Moreover, the only strong correlation is between access to finance and provision of additional food sources. From these results, it can be concluded that the adaptive capacity of the area is more related to access to (in)formal learning, increased participation and awareness, and access to finance than to that of wellbeing, flexibility, cooperation, and agency.

Secondly, the statistical assessment of the project points out that most of the relationships between adaptive capacity and natural vulnerability are very weak. The only weak correlations being between the adaptive capacity indicator of willingness of locals to address climate-related issues and the natural vulnerability indicators of the level of risk of flooding within the WnZ area, risk of flooding of cultural properties, and risk of erosion. Furthermore, the relationship between adaptive capacity and socio-economic vulnerability is mostly very weak. The only weak relationships are between the adaptive capacity indicators of enhanced wellbeing, flexibility, and cooperation with population density. These relationships, however weak do indicate that the adaptive capacity does influence certain vulnerability indicators and vice-versa (Nicholls et al., 2008; Oliver – Smith, 2009; Locatelli et al., 2008).

When qualitatively assessing the ES provided with that of the natural vulnerability it is apparent that the halting of land degradation and the regeneration of mangroves are the most important ES indicators. These contribute to the reduction of the level of risk of erosion and flooding within the WnZ area. Moreover, from the statistical analysis, it becomes clear that most of the relationships between the indicators are very weak, with some weak correlations. From the statistical and qualitative analysis between ES provided and socio-economic vulnerability, it is found that there is no significant correlation or co-occurrence between them, indicating that no relationship is present between these concepts. These findings are contradictory to that of Himes – Cornell, (2018) in which the ES derived from NbS addresses socio-economic and natural vulnerability simultaneously.

5.1.5 Reflection Conceptual Framework

From the above-mentioned results, it can be concluded that ES provided by NbS directly influences the adaptive capacity of an area and its population, which can then influence the natural and socio-economic vulnerability and vice versa. Moreover, it can be derived that ES has a minimal direct influence on natural vulnerability and no influence on socio-economic vulnerability. These findings specify the need to switch the position of adaptive capacity and vulnerability within the conceptual framework of chapter 2, resulting in adaptive capacity becoming the dependent variable to ES due to the direct link with ES and Vulnerability becoming the moderating variable to this direct relationship. However, this revised conceptual framework is specific to this project and cannot be generalized as of yet.

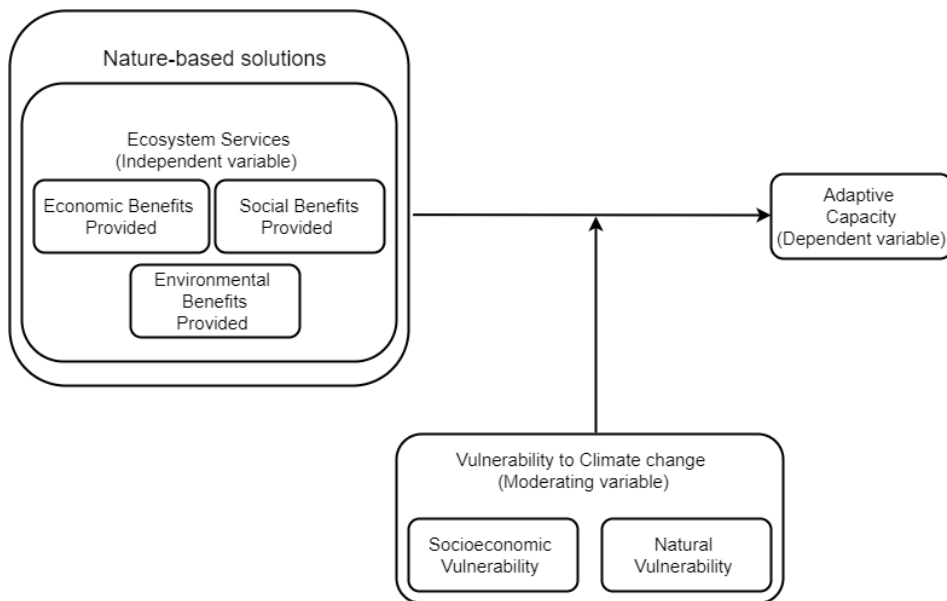


Figure 7: Revised Conceptual Framework

5.2 Suggestion for Future Work

Within this study quantitative data was collected from the locals via questionnaires. For this reason, further qualitative data collection of the locals can be useful. The usage of focus groups would contribute to the creation of more in-depth data regarding the local population their perception of the project and could help with uncovering certain behavioral patterns of the community. However, this approach could not take place due to time and budget constraints and the pandemic measures taken by the local government during the period of data collection. A limitation of this study is that 165 of the targeted 384 questionnaires were achieved, resulting in a bigger margin of error of the results in the study. Further collection of questionnaires could not take place due to time constraints.

Furthermore, from the interviews, it was derived that a similar project was implemented in a different district. It would be interesting to conduct similar research on this case study contributing to the creation of an evidence base regarding ES provided by NbS and its effect on the adaptive capacity and vulnerability of an area.

Moreover, participation which can be seen as an important characteristic for the success of NbS (Frantzeskaki, 2019), is currently lacking in the project. For this reason, it would be interesting to conduct more in-depth research as to what is causing this lack of participation by the locals.

Lastly, initial steps have been taken to increase tourism and the availability of jobs. However, these results are not yet visible therefore, this research could not fully assess the effects that the project has had on these aspects, indicating the need for further research in a later stage.

Bibliography

- Aguilar, R., Fujis, T., Lakner, C., Mahler, D., Nguyen, M., Schoch, M., & Viveros, M. (2021, March 16). *March 2021 global poverty update from the World Bank*. World Bank Blogs. <https://blogs.worldbank.org/opendata/march-2021-global-poverty-update-world-bank>
- Babí Almenar, J., Elliot, T., Rugani, B., Philippe, B., Navarrete Gutierrez, T., Sonnemann, G., & Geneletti, D. (2021). Nexus between nature-based solutions, ecosystem services and urban challenges. *Land Use Policy*, *100*, 1–22. <https://doi.org/10.1016/j.landusepol.2020.104898>
- Bevacqua, A., Yu, D., & Zhang, Y. (2018). Coastal vulnerability: Evolving concepts in understanding vulnerable people and places. *Environmental Science & Policy*, *82*, 19–29. <https://doi.org/10.1016/j.envsci.2018.01.006>
- Bryman, A. (2012). *Social Research Methods* (4th ed., Vol. 3). Oxford University Press. https://www.academia.edu/38228560/Alan_Bryman_Social_Research_Methods_4th_Edition_Oxford_University_Press_2012_pdf
- Burkhard, B., Kroll, F., Nedkov, S., & Müller, F. (2012). Mapping ecosystem service supply, demand and budgets. *Ecological Indicators*, *21*, 17–29. <https://doi.org/10.1016/j.ecolind.2011.06.019>
- Cete, C., Haagse, S., Hardwarsing, V., Kalloe, S., & Ma-Ajong, A. (2018, May). *Mangrove Project Suriname*. TU Delft. <https://repository.tudelft.nl/islandora/object/uuid%3Ae7c215e1-ac14-4b91-85e3-646c3e37b7d0>
- Cinner, J. E., Adger, W. N., Allison, E. H., Barnes, M. L., Brown, K., Cohen, P. J., Gelcich, S., Hicks, C. C., Hughes, T. P., Lau, J., Marshall, N. A., & Morrison, T. H. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nature Climate Change*, *8*(2), 117–123. <https://doi.org/10.1038/s41558-017-0065-x>
- Conservation international. (2021). *Building With Nature*. Conservation International Suriname. <https://www.conservation.org/suriname/programs/building-with-nature>
- Dolan, A. H., & Walker, I. J. (2006). Understanding Vulnerability of Coastal Communities to Climate Change Related Risks. *Journal of Coastal Research*, *39*, 1316–1323. https://www.researchgate.net/publication/228757759_Understanding_vulnerability_of_coastal_communities_to_climate_change_related_risks
- Doukakis, E. (2005). Coastal vulnerability and risk parameters. *Ewra*, 1–5. https://www.ewra.net/ew/pdf/EW_2005_11-12_01.pdf
- Eisenberg, B., & Polcher, V. (2019, February). *Nature Based Solutions - Technical Handbook*. Institute of Landscaping Planning and Ecology. https://www.researchgate.net/publication/332230725_Nature_Based_Solutions_-_Technical_Handbook

- Ellen, S. (2020, December 14). *Slovin's Formula Sampling Techniques*. Sciencing. <https://sciencing.com/slovins-formula-sampling-techniques-5475547.html>
- Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Environmental Change*, *21*(2), 647–656. <https://doi.org/10.1016/j.gloenvcha.2011.01.019>
- Faivre, N., Fritz, M., Freitas, T., de Boissezon, B., & Vandewoestijne, S. (2017). Nature-Based Solutions in the EU: Innovating with nature to address social, economic and environmental challenges. *Environmental Research*, *159*, 509–518. <https://doi.org/10.1016/j.envres.2017.08.032>
- Flórez Bossio, C., Ford, J., & Labbé, D. (2019). Adaptive capacity in urban areas of developing countries. *Climatic Change*, *157*(2), 279–297. <https://doi.org/10.1007/s10584-019-02534-2>
- Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental Science & Policy*, *93*, 101–111. <https://doi.org/10.1016/j.envsci.2018.12.033>
- Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*, *16*(3), 293–303. <https://doi.org/10.1016/j.gloenvcha.2006.02.004>
- Gandhi, S., & Jones, T. (2019). Identifying Mangrove Deforestation Hotspots in South Asia, Southeast Asia and Asia-Pacific. *Remote Sensing*, *11*(6), 1–27. <https://doi.org/10.3390/rs11060728>
- Gedan, K. B., Kirwan, M. L., Wolanski, E., Barbier, E. B., & Silliman, B. R. (2010). The present and future role of coastal wetland vegetation in protecting shorelines: answering recent challenges to the paradigm. *Climatic Change*, *106*(1), 7–29. <https://doi.org/10.1007/s10584-010-0003-7>
- General Bureau of Statistics. (2016). Mozaïek van het Surinaamse volk: Volkstelling in demografisch, economisch en sociaal perspectief. <https://www.statistics-suriname.org/wp-content/uploads/2019/02/mozaiek-van-het-surinaamse-volk-versie-5.pdf>
- Grafakos, S., Trigg, K., Landauer, M., Chelleri, L., & Dhakal, S. (2019). Analytical framework to evaluate the level of integration of climate adaptation and mitigation in cities. *Climatic Change*, *154*(1–2), 87–106. <https://doi.org/10.1007/s10584-019-02394-w>
- Harrison, P. A., Dunford, R., Barton, D. N., Kelemen, E., Martín-López, B., Norton, L., Termansen, M., Saarikoski, H., Hendriks, K., Gómez-Baggethun, E., Czucz, B., García-Llorente, M., Howard, D., Jacobs, S., Karlsen, M., Kopperoinen, L., Madsen, A., Rusch, G., van Eupen, M., . . . Zulian, G. (2018). Selecting methods for ecosystem service assessment: A decision tree approach. *Ecosystem Services*, *29*, 481–498. <https://doi.org/10.1016/j.ecoser.2017.09.016>

- Himes-Cornell, A., Pendleton, L., & Atiyah, P. (2018). Valuing ecosystem services from blue forests: A systematic review of the valuation of salt marshes, sea grass beds and mangrove forests. *Ecosystem Services*, 30, 36–48. <https://doi.org/10.1016/j.ecoser.2018.01.006>
- International Bank MMXVII. (2017, December). *Coastal Resilience Assessment*. World Bank Group. <http://documents1.worldbank.org/curated/en/684611538551863364/pdf/Suriname-Coastal-Resilience-Assessment-Feb-9-Low-Res.pdf>
- IPCC, Pachauri, R. K., & Meyer, L. (2015). *Climate Change 2014 Synthesis Report* (5th ed., Vol. 2014). Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf
- Kabir, S. M. S. (2016). Methods of data collection. In *Basic Guidelines for Research: An Introductory Approach for All Disciplines*. (pp. 201–275). Chittagong: Book Zone Publication. https://www.researchgate.net/publication/325846997_METHODS_OF_DATA_COLLECTION
- Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecology and Society*, 21(2), 1–15. <https://doi.org/10.5751/es-08373-210239>
- Klein, R. J. T., & Nicholls, R. J. (1999). Assessment of Coastal Vulnerability to Climate Change. *Springer*, 28, 182–187. <https://www.jstor.org/stable/pdf/4314873.pdf>
- Kopsieker, L., Gerritsen, E., Stainforth, T., Lucic, A., Domingo, G. C., Naumann, S., Rochel, L., & Davis, M. (2021). *Nature-based solutions and their socio-economic benefits for Europe's recovery: Enhancing the uptake of nature-based solutions across EU policies*. IEEP. [https://ieep.eu/uploads/articles/attachments/0b733817-b56a-4872-afc9-43ccff2ad6ba/Nature-based%20solutions%20and%20their%20socio-economic%20benefits%20for%20Europe%E2%80%99s%20recovery%20\(IEEP%202021\)%20WEB.pdf?v=63781383755](https://ieep.eu/uploads/articles/attachments/0b733817-b56a-4872-afc9-43ccff2ad6ba/Nature-based%20solutions%20and%20their%20socio-economic%20benefits%20for%20Europe%E2%80%99s%20recovery%20(IEEP%202021)%20WEB.pdf?v=63781383755).
- Laukkonen, J., Blanco, P. K., Lenhart, J., Keiner, M., Cavric, B., & Kinuthia-Njenga, C. (2008). Combining climate change adaptation and mitigation measures at the local level. *Habitat International*, 33(3), 287–292. <https://doi.org/10.1016/j.habitatint.2008.10.003>
- Liang, Y., Abbott, D., Howard, N., Lim, K., Ward, R., & Elgendi, M. (2019). How Effective Is Pulse Arrival Time for Evaluating Blood Pressure? Challenges and Recommendations from a Study Using the MIMIC Database. *Journal of Clinical Medicine*, 8(3), 1–14. <https://doi.org/10.3390/jcm8030337>
- Linnekamp, F. (2010). Klimaatverandering: Paramaribo overstroomt. *Rooilijn*, 43(3), 216–221. <http://archieff.rooilijn.nl/download?type=document&identifier=623093>

- Linnekamp, F., Koedam, A., & Baud, I. (2011). Household vulnerability to climate change: Examining perceptions of households of flood risks in Georgetown and Paramaribo. *Habitat International*, 35(3), 447–456. <https://doi.org/10.1016/j.habitatint.2010.12.003>
- Locatelli, B., Kanninen, M., Brockhaus, M., Pierce Colfer, C. J., Murdiyarsa, D., & Santoso, H. (2008). *Facing an Uncertain Future* (Forest perspectives ed., Vol. 5). Center for International Forestry Research. https://www.cifor.org/publications/pdf_files/media/CIFOR_adaptation.pdf
- McNamara, K. E., & Buggy, L. (2016). Community-based climate change adaptation: a review of academic literature. *Local Environment*, 22(4), 443–460. <https://doi.org/10.1080/13549839.2016.1216954>
- Ministry of Foreign Affairs, General Bureau of Statistics, & UNDP Suriname. (2014, November). *GOVERNMENT OF THE REPUBLIC OF SURINAME MDG PROGRESS REPORT 2014*. UNDP Suriname. https://www.statistics-suriname.org/wp-content/uploads/2019/02/MDG_2014_WEB_00_10.pdf
- Nicholls, R. J., Wong, P. P., Burkett, V., Woodroffe, C. D., & Hay, J. (2008). Climate change and coastal vulnerability assessment: scenarios for integrated assessment. *Sustainability Science*, 3(1), 89–102. <https://doi.org/10.1007/s11625-008-0050-4>
- Oliver-Smith, A. (2009). *Sea Level Rise and the Vulnerability of Coastal Peoples* (Vol. 1). UNU-EHS. https://www.unisdr.org/files/14028_4097.pdf
- Owen, G. (2020). What makes climate change adaptation effective? A systematic review of the literature. *Global Environmental Change*, 62, 102071. <https://doi.org/10.1016/j.gloenvcha.2020.102071>
- Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., Geneletti, D., & Calfapietra, C. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy*, 1(10), 15–24. <https://doi.org/10.1016/j.envsci.2017.07.008>
- Sea Level Rise and the Vulnerability of Coastal Peoples* (No. 7). (2009). InterSecTions. <http://collections.unu.edu/eserv/UNU:1861/pdf4097.pdf>
- Seddon, N., Chausson, A., Berry, P., Girardin, C. A. J., Smith, A., & Turner, B. (2019). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1794), 20190120. <https://doi.org/10.1098/rstb.2019.0120>
- Sharma, J., & Ravindranath, N. H. (2019). Applying IPCC 2014 framework for hazard-specific vulnerability assessment under climate change. *Environmental Research Communications*, 1(5), 1–7. <https://doi.org/10.1088/2515-7620/ab24ed>
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282–292. <https://doi.org/10.1016/j.gloenvcha.2006.03.008>

- Stichting Planbureau Suriname. (2014, December). *Structuur Analyse Districten*. <https://www.planningofficesuriname.com/publicaties/planbureau-geeft-publicatie-structuuranalyse-van-de-districten-iv-uit/>
- TEEB. (2011). *The Economics of Ecosystems & Biodiversity*. http://www.teebweb.org/wp-content/uploads/Study%20and%20Reports/Additional%20Reports/Manual%20for%200Cities/TEEB%20Manual%20for%20Cities_English.pdf
- Thiel, S. (2014). *Research Methods in Public Administration and Public Management* (1st ed., Vol. 2014). Routledge.
- Toorman, E. A., Anthony, E., Augustinus, P. G. E. F., Gardel, A., Gratiot, N., Homenauth, O., Huybrechts, N., Monbaliu, J., Moseley, K., & Naipal, S. (2018). Interaction of Mangroves, Coastal Hydrodynamics, and Morphodynamics Along the Coastal Fringes of the Guianas. *Coastal Research Library*, 429–473. https://doi.org/10.1007/978-3-319-73016-5_20
- UNDP & Government of Suriname. (2019). *Suriname National Adaptation Plan (NAP)*. Government of Suriname, 2019. https://www4.unfccc.int/sites/NAPC/Documents/Parties/Suriname%20Final%20NAP_apr%202020.pdf
- Vignola, R., Koellner, T., Scholz, R. W., & McDaniels, T. L. (2010). Decision-making by farmers regarding ecosystem services: Factors affecting soil conservation efforts in Costa Rica. *Land Use Policy*, 27(4), 1132–1142. <https://doi.org/10.1016/j.landusepol.2010.03.003>
- Vo, Q. T., Kuenzer, C., Vo, Q. M., Moder, F., & Oppelt, N. (2012). Review of valuation methods for mangrove ecosystem services. *Ecological Indicators*, 23, 431–446. <https://doi.org/10.1016/j.ecolind.2012.04.022>
- Vohland, K., Walz, A., Popp, A., Lotze-Campen, H., & Cramer, W. (2012). The Role of Ecosystem Services in Increasing the Adaptive Capacity of the Poor. *Climate Change, Justice and Sustainability*, 179–191. https://doi.org/10.1007/978-94-007-4540-7_17
- Waterkant. (2020, September 27). *Start aanplant bamboe te Weg naar Zee*. <https://www.waterkant.net/suriname/2020/09/27/video-start-aanplant-bamboe-te-weg-naar-zee/>

Annex 1: Research Instruments and Time schedule

Questionnaire

<https://docs.google.com/forms/d/e/1FAIpQLSc5ErHem5Rl9wvPazzfmDI9KgwSU17HfdzYWMO07Sof9jjaHg/viewform>

Interview Guide

A Introduction

Good day,

Hi, my name is Dion Wip and the interview that is being conducted is a part of my thesis project at the Urban Management and Development Master's program at the Institute for housing and urban development studies (IHS) at Erasmus. This interview aims to assess the professionals who are involved in the project their perceptions and noteworthy assessments of the "Building with nature" project along the coastal area. This in the context of how it has contributed to the adaptive capacity and vulnerability of the local citizens.

This interview should take approximately 30 minutes to complete and would contribute immensely to the research.

Before we begin with the interview, I would like to ask you for your permission to record this interview which would help with the transcription of the interview enabling me to interpret and assess given answers more thoroughly afterward. The interview will safely be stored on the online platform provided by Erasmus university called SURFdrive.

B Open-ended interview questions

1. In what way are you connected to the project and how did this occur?
2. What would you say is the level of risk of the Weg naar Zee area to erosion and coastal flooding especially that of commercial, cultural, and residential properties?
3. How has the "Building with nature" project influenced the land degradation taking place at the Weg naar Zee area and how has that influenced the coastal damages?
4. How has the project affected the regeneration of mangrove forests and biodiversity within the Weg naar Zee area?
5. Has the project contributed to the creation of more and or diverse jobs?
6. In what way has the project influenced tourism within the area?
7. How has the project influenced the food production of the Weg naar Zee area?
8. Has the project contributed to the addition of social benefits within the area such as educational benefits?
9. What is the level of inclusion of locals within the project?
10. In what way is the project incorporating cooperation between the different stakeholders of the project?
11. How is sharing of knowledge with regards to climate change and mangroves taking place between the different stakeholders?
12. What is the level of local participation and awareness regarding the project and climate change?
13. Has the project created new methods of income for the local people of Weg naar Zee?
14. Has the project made it easier for the area to adapt to new strategies and climate situations?

C Concluding remark /question

Now that we have reached the end of my questions, I would invite you to feel free to add comments and or bring related topics forward which have not been covered but are relevant to address for this research.

If you wish to add nothing else to the interview, I would like to thank you for your time and useful input in this interview which contributes immensely to the research. Furthermore, if you are interested in the results regarding this research and how your responses have been interpreted, I am glad to provide you with a copy of my thesis.

Table 21: Thesis Timetable, 2021.

No.	Activity	Time Frame	Dates 2021	Responsible
1	Chapter 1-3 (Full Proposal) with Questionnaire and Interview guide	2 months	21 June	Student/Supervisor
2	GO/No Go Decision	3 days	25 June	Student/Exam Committee
3	Field work/Data Collection	1 month	16 July	Student
4	Data Analysis & Thesis Writing	1 month	30 July	Student
5	Submission of Draft Thesis	1 month	9 August	Student/Supervisor
6	first Submission of the final thesis	1 day	30 August	Student/Supervisor
7	Thesis Defence	3 days	6-9 September	Student/Exam Committee
8	Closing Ceremony	1 day	17 September	

Annex 2: Correlation tables

Table 1: Correlation between Ecosystem Services and Adaptive Capacity

	Halting of land degradation	Increase in biodiversity	Tourism	Job creation	Provision of additional food sources	Reduction of coastal damages	Recreational uses provided	Cultural and or spiritual services provided and or maintained	Educational services provided	Regeneration of mangrove forest	Involvement in NbS projects
Access to finance	0.386*	0.328*	0.577*	0.557*	0.606*	0.440*	0.488*	0.472*	0.292*	0.239*	0.052*
Enhanced wellbeing of local citizens	0.401*	0.460*	0.384*	0.300*	0.518*	0.538*	0.407*	0.415*	0.459*	0.470*	0.036*
Flexibility to switch between climate related strategies	0.453*	0.463*	0.346*	0.392*	0.522*	0.549*	0.445*	0.411*	0.404*	0.551*	-0.005*
Formal and informal cooperation between communities and stakeholders	0.333*	0.420*	0.300*	0.401*	0.500*	0.411*	0.388*	0.381*	0.378*	0.522*	-0.011*
Access to formal and informal learning regarding climate change and mangroves											
Information received regarding the project and climate change	-0.178*	-0.124	-0.164*	-0.105	-0.088	-0.133	-0.159*	-0.112	-0.151	-0.229*	0.316*
Willingness of locals to share knowledge with other locals regarding flood protection	0.355*	0.448*	0.244*	0.215*	0.249*	0.434*	0.330*	0.403*	0.528*	0.449*	-0.115
Increased local participation and awareness regarding climate change and mangroves											
Willingness to participate in future workshops	0.282*	0.398*	0.196*	0.144	0.180*	0.268*	0.203*	0.338*	0.459*	0.290*	-0.275*
Willingness to volunteer in future workshops	0.316*	0.401*	0.174*	0.149	0.226*	0.335*	0.234*	0.303*	0.469*	0.441*	-0.276*
Willingness to financially contribute to the project	0.349*	0.235*	0.118	0.210*	0.206*	0.241*	0.200*	0.246*	0.346*	0.311*	-0.164*
Willingness of locals to address climate risk	0.335*	0.362*	0.202*	0.178*	0.235*	0.408*	0.315*	0.272*	0.506*	0.442*	-0.075

*Correlation is significant at the 0.05 level

Table 2: Correlation between Adaptive Capacity and Natural and Socio-economic Vulnerability

	Access to finance	Enhanced wellbeing of local citizens	Flexibility to switch between climate-related strategies	Formal and informal cooperation between communities and stakeholders	Increased local participation and awareness regarding climate change and mangroves			Access to formal and informal learning regarding climate change and mangroves		Willingness of locals to address climate risk
					Willingness to participate in future workshops	Willingness to volunteer in future workshops	Willingness to financially contribute to the project	Willingness of locals to share knowledge with other locals regarding flood protection	Information received regarding the project and climate change	
Level of risk of erosion within the WnZ area	0.043	-0.015	0.123	0.052	0.066	0.051	-0.070	0.131	0.032	0.208*
Level of risk of flooding within the WnZ area	0.098	0.055	0.112	-0.010	0.140	0.066	-0.031	0.216*	0.032	0.245*
Level of risk of flooding of commercial properties	0.115	0.023	0.095	0.016	0.053	-0.017	-0.041	0.137	0.020	0.173*
Risk of flooding of cultural properties	0.144	0.049	0.142	0.045	0.122	0.100	0.040	0.194*	0.018	0.238*
Risk of flooding of residential properties	0.124	0.082	0.148	0.012	0.108	0.049	-0.021	0.148	0.013	0.189*
Average income within the WnZ area	-0.011	-0.111	-0.075	-0.046	0.082	0.125	0.161*	-0.019	-0.065	0.008
Presence of recreational and social facilities	-0.041	-0.049	0.047	0.036	0.066	0.110	0.047	0.067	-0.152	0.060
Population density	0.048	0.220*	0.216*	0.217*	0.123	0.137	0.154*	0.086	0.014	0.088
Level of education	0.067	-0.021	-0.053	0.038	0.080	0.083	0.015	0.047	-0.030	-0.055

*Correlation is significant at the 0.05 level

Table 3: Correlation between Ecosystem Services and Natural and Socio-economic Vulnerability

	Halting of land degradation	Increase in biodiversity	Tourism	Job creation	Provision of additional food sources	Reduction of coastal damages	Recreational uses provided	Cultural and or spiritual services provided and or maintained	Educational services provided	Regeneration of mangrove forest	Involvement in NbS projects
Level of risk of erosion within the WnZ area	0.019	0.020	-0.012	0.139	-0.062	0.094	0.000	0.071	0.190*	0.144	0.039
Level of risk of flooding within the WnZ area	0.086	0.137	0.002	0.093	0.019	0.171*	0.046	0.099	0.274*	0.085	-0.074
Level of risk of flooding of commercial properties	0.092	0.119	0.017	0.159*	0.084	0.155*	0.147	0.102	0.163*	0.021	0.022
Risk of flooding of cultural properties	0.109	0.129	-0.007	0.148	0.066	0.203*	0.102	0.125	0.224*	0.077	0.006
Risk of flooding of residential properties	0.104	0.129	-0.014	0.100	0.060	0.185*	0.100	0.081	0.226*	0.087	-0.008
Average income within the WnZ area	-0.048	-0.051	-0.018	-0.077	-0.076	-0.048	-0.050	-0.014	-0.047	-0.030	0.026
Presence of recreational and social facilities	0.084	0.072	-0.046	0.044	0.062	-0.018	-0.020	0.131	0.012	0.135	-0.075
Population density	0.110	0.152	0.096	0.051	0.122	0.053	0.065	0.115	0.073	0.183*	-0.032
Level of education	0.086	-0.017	-0.130	-0.016	-0.071	-0.016	-0.094	0.062	0.087	0.038	0.025

*Correlation is significant at the 0.05 level

Annex 3: IHS copyright form

In order to allow the IHS Research Committee to select and publish the best UMD theses, participants need to sign and hand in this copy right form to the course bureau together with their final thesis.

Criteria for publishing:

1. A summary of 400 words should be included in the thesis.
2. The number of pages for the thesis is about 50.
3. The thesis should be edited

Please be aware of the length restrictions of the thesis. The Research Committee may choose not to publish very long and badly written theses.

By signing this form you are indicating that you are the sole author(s) of the work and that you have the right to transfer copyright to IHS, except for items cited or quoted in your work that are clearly indicated.

I grant IHS, or its successors, all copyrights to the work listed above, so that IHS may publish the work in *The IHS thesis series*, on the IHS web site, in an electronic publication or in any other medium.

IHS is granted the right to approve reprinting.


The author(s) retain the rights to create derivative works and to distribute the work cited above within the institution that employs the author.

Please note that IHS copyrighted material from *The IHS thesis series* may be reproduced, up to ten copies for educational (excluding course packs purchased by students), non-commercial purposes, providing full acknowledgements and a copyright notice appear on all reproductions.

Thank you for your contribution to IHS.

Date : August 30,2021

Your Name(s) : Dion Almar Mitchell Wip

Your Signature(s) : 

Please direct this form and all questions regarding this form or IHS copyright policy to:

The Chairman, IHS Research Committee Burg. Oudlaan 50, T-Building 14 th floor, 3062 PA Rotterdam, The Netherlands	j.edelenbos@ihs.nl Tel. +31 10 4089851
--	--

