



# Reducing risk for erosion in Maldives

## Comparative case study of local people's and resort's adaptive capacity in Laamu atoll

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**Environmental Science**

Thesis for master's degree 30 credits

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# Abstract

This study is a comparative case study and investigates how local people on two islands called Maamendhoo and Maavah, and one resort operator called Six Senses in Laamu atoll, Maldives reduce their risk for erosion. This has been done by performing capacity analyses for these islands and the information has been collected mainly from interviews. The capacity analyses are based on which adaptive capacity they have regarding the risk reduction and adaptation measures; hazard reduction and avoidance, vulnerability reduction, preparedness for response and preparedness for recovery. It involves how local people and the resort operator both have adapted in the past and how they currently adapt (used capacity). Further it involves how they plan to adapt, which lacking capacities and also which unused capacities they have. The capacity analyses are analyzed to see if there are any gaps or weaknesses in their adaptive work and if the adaptive capacity differ between the resort island and the local islands and what the reason for this may be. The result from the capacity analyses shows that the resort have a lot of used capacity and implement many measures to reduce their risk to beach erosion compared to what local people have. The reason for this is mainly because the resort have more economic capacity to implement measures against erosion. The study shows that local people have more gaps in their adaptive work since they do not use all the measures and they have much more unused and lacking capacities compared to the resort island. The study is also investigating the interaction between local people/the resort and authorities. The result shows that authorities and Six Senses are supporting each others work with erosion, they are complementing each others work and the authorities are assisting with the resources the resort is requesting. The result also shows that local people do not think the authorities are supporting them in their adaptation work. The local people are complementing the authorities gaps/weaknesses in their adaptation work to a certain extent. The local people do not in general get the help they are requesting from the authorities, and they think that the authorities have not done enough to prevent the risk of erosion.

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# List of abbreviations

CCA	Climate Change Adaptation
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
LAC	Laamu Atoll Council
LeCRED	Low emission and Climate Resilient Development
LGA	Local Government Authority
MaIC	Maamendhoo Island Council
MEE	Ministry of Environment and Energy
MEEW	Ministry of Environment, Energy and Water
MHE	Ministry of Housing and Environment
MHI	Ministry of Housing and Infrastructure
MMS	Maldivian Meteorological Service
MRC	Maldivian Red Crescent
MT	Ministry of Tourism
MvIC	Maavah Island Council
NDMC	National Disaster Management Center
RR	Risk Reduction
UNISDR	United Nations Office for Disaster Risk Reduction
UNDP	United Nations Development Programme

# 1. Introduction

Maldives is an island nation located in the Indian Ocean, consisting of 26 atolls and almost 1200 islands (NDMC, 2009) (see figure 1; (BE, 2014). An atoll consists of several small islands and sand banks and are created from coral reefs (Abdulla, 2007) Maldives has around 320 000 inhabitants (2010) and its capital is Malé (UNdata, 2014). It is one of the world's lowest situated countries where over 80% of the land area is less than 1 meter above mean sea level (UNDP, 2013). More than 70% of all important infrastructures are situated, and 42% of the population lives, within 100 m from the coastline (UNDP, 2008). The country is therefore vulnerable to the sea level rise that we see as a result of a warmer climate. Nearly 85% of its geographic area could be under water by the year 2100 if sea levels rise under more extreme projections (Khan et al., 2002). The sea level rises because of melting ice sheets and thermal expansion of the ocean, and this process is expected to continue in the future due to climate change (Bernes, 2007). When the mean sea level rises the Maldives will be more exposed to beach erosion (NDMC, 2009). More than 97% of inhabited islands in Maldives reported beach erosion in 2004, of which 64% reported severe beach erosion (Shaig, 2006). This fact is one of the reasons why this study is performing capacity analyses of how local people on two islands called Maamendhoo and Maavah and also how the resort island Six Senses in Laamu atoll in Maldives adapt to beach erosion, and also how they differ. It is important to know how to reduce risk against erosion so that people will be less exposed to hazards in a changed climate. Climate adaptation and disaster risk management are therefore a crucial subject to investigate and the main focus of this study.



Figure 1. Map of Maldives and its atolls. Laamu atoll is on this map called Hadhdhunmathee atoll (BE, 2014).

## 1.1 Previous studies

One study has been found about how local people and communities in Maldives are adapting to beach erosion problems (MHE, 2011). This study focus on measures that have been taken and the costs for this. The present study is more comprehensive by including a capacity analysis and also the interaction between the authorities and local people. This study therefore aims at filling the gap in the academic field of disaster risk management by including the Maldivian context with this case study.

Regarding resort islands one study has been found called *Baseline Analysis of Adaptation Capacity and Climate Change Vulnerability Impacts in the Tourism Sector* (MT, 2013). The main objective with this study

is to assess the current adaptive capacity of the tourism sector in Maldives regarding response to the impact of climate change, where beach erosion is included. This study also investigates how ready different institutions are to handle these issues. Since the present study is comparing local islands with resort islands, the present study wants to contribute with a new aspect, that has not been found in literature regarding Maldives.

## 1.2 Aim of the study

The main aim of this study is to perform capacity analyses of the adaptive practices and capacities of local inhabitants and one resort in Laamu atoll in Maldives regarding beach erosion problems. This is analyzed by investigating how they have adapted in the past, how they currently adapt (used capacity), and how they in the future adapt to beach erosion. The study further investigates if there are any gaps and weaknesses in the local people's and the resort's adaptive work, by analyzing which lacking capacities and unused capacities that are found, and if they prioritize any specific kind of adaptive measures. The methodology is based on the operational framework of Wamsler (2014). The study is also investigating if the adaptive capacity differs between resort islands and local islands, and what the reason for this may be. The reason why one resort island is compared with two local islands on Maldives is because no study has been found about how they differ in their adaptive work against erosion. Resort islands and local islands are also very segregated from each other and it is interesting to investigate how they differ since Maldives is very dependent on their tourist industry.

Finally this study will propose measures and strategies for local people and the resort Six Senses to adapt to current and future risks related to erosion, in order to improve the current situation.

### 1.2.1 Comparison with the study of Englund (2014)

The field study in Maldives was carried out during nine weeks in March and April in 2014 and is a joint study with Bodil Englund. This means that the interviews with both authorities on different levels (during both the pre-study and the main study), local people on Maamendhoo and Maavah, and the resort Six Senses Laamu, and how they adapt to beach erosion were conducted together. The results from the interviews with local people on Maamendhoo and Maavah and the resort Six Senses Laamu are presented in this study, while the results from the interviews with the Maldivian authorities on national, regional (Laamu atoll council) and local level (Island councils on Maavah and Maamendhoo) are presented in the study of Englund (2014). The interview guides were compiled together and revised as more information about the situation was gathered from the interviews.

The operational framework of Wamsler (2014) is being used in both of the studies, (see chapter 3), as an analytical tool to carry out capacity analyses of the adaptive capacities of authorities and local people/one resort, and how well their work complement each other regarding problems related to beach erosion. The theoretical chapter is shared in both of the studies, since the same theory of Wamsler is being used.

Both of the studies aim to compare each other's result to investigate and analyze the interaction between local people and authorities in Maldives. This study is investigating; a) how local people perceive the authorities adaptation work against erosion; b) if the adaptive measures taken by local people are hindered or supported by authorities; c) if the adaptive measures taken by local people are complimenting the authorities adaptive work and; d) if the authorities are assisting with the adaptive help that local people are requesting. Information from interviews in this study is compiled and compared with information from interviews from Englund's study (2014). The comparative result and a following discussion are therefore shared in both studies. In this study the interaction between local people and authorities is presented in section 5.4 and the following discussion is presented in section 6.1.2.

The reports of both of the studies stand alone. The results from the capacity analyses in the study of Englund (2014) are attached to appendix A in order to assist the reader.

## 1.2.2 Research questions

Main research question:

- How do local people and one resort operator reduce their risk from damages from beach erosion and how does the adaptive capacity differ between local islands and one resort island in Laamu atoll on Maldives?

To help answer the main research question the following questions will be answered:

- Are there any gaps or weaknesses in the adaptive work and measures that local people and one resort operator take against beach erosion?
- How does the local peoples' and one resort operator's adaptive work interact with the authorities adaptive work with problems following beach erosion?

## 1.3 Environmental relevance

The environmental relevance of this study is the focus upon on the fact that disaster risk management involves climate adaptation to natural hazards. Because of climate change, natural hazard events have increased the last decades (UNISDR, 2012b). A changing climate per se is something that people generally are not used to handle and this naturally increases the vulnerability of people and society. Since climate change has increased both peoples vulnerability and the number of hazard events, it has also increased the number of disasters. These disasters have resulted in increasing human and economic losses like; loss of lives, damaged houses and infrastructure, and caused a shortage of food and water around the world. Disasters only occur when natural hazards are combined with vulnerable conditions. This means that if a community has the capacity or resources to withstand a natural hazard it is less vulnerable and the disaster may not become that severe.

### 1.3.1 Sea level rise, storms and erosion

In the future the number of disasters are expected to increase because of climate change (Blodgett & Keller, 2008). The global mean temperature is rising and a higher temperature lead to more natural hazardous events. To give some examples, when the sea gets warmer its water volume expands and when the temperature rises inland ice caps and glaciers will melt as a result. Following this the sea level will rise. When the sea gets warmer more energy is brought into the atmosphere and the magnitude and frequency of hazardous weather events like hurricanes and thunderstorms will most likely increase. Higher sea level in combination with stronger winds and higher waves may develop great erosive forces along the coast. Some beaches are growing because more sediment is transported and stored there, so called *accumulation*, while some coastlines are decreasing because the output of sediment exceeds the input and in turn creates *erosion*. In Maldives erosion is a natural process, since the two different monsoon seasons change the direction of the wind direction and in turn the ocean currents when the monsoon shifts (MMS, 2014a). This causes an increased movement of material and sand around the different islands in Maldives. From December to the beginning of May Maldives experience a dry northeast monsoon with sunny and calm weather. In the mid of May the monsoon shifts and the weather gets windy and stormy with the southwest monsoon that runs to November. Although erosion is a natural process, it's impacts may be exacerbated due to climate change hazards. Erosion can also be caused by human activities due to alteration of the coastal environment, like harbor construction and land reclamation (UNDP, 2007). This can disturb the balance of natural processes along the coastline. Other human activities are removal of vegetation for settlement purposes. This is harmful as vegetation stabilizing the sand and minimizing the impact of strong winds. Also removal of corals from the reefs by local people increase the impact of waves and currents and in turn erosion, since coral reefs function as natural breakwaters (Maamendhoo, 2014).

In Maldives the people are already very vulnerable to sea level rise and erosion since it is one of the most low lying countries in the world. When the sea level rises it will be increasingly exposed to erosion and

authorities and locals need need to find solutions so that they can adapt to the changing climate and its effects in the future. That is why it is so important for people to gain knowledge about how to adapt to climate change.

## 1.4 Limitations

A capacity analysis is a part of a basic risk assessment, but for time- and budget limitations this study has only performed capacity analyses<sup>1</sup> and no risk assessment.

Focus in this study is on the individual level and not on communities (civil society), since interviews have only been carried out with local people. NGO:s could not be found on any of the islands. A limitation was drawn only to interview local people that could speak english since it was hard to find an interpreter on the different islands.

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<sup>1</sup> For more information about what is included in a basic risk assessment, see Wamsler (2014), p. 40,



## 2. Background

### 2.1 Resort islands and local islands

In Maldives there are mainly three types of islands: local islands, resort islands and uninhabited islands (UNDP, 2013). Resort islands consists of one resort where holiday guests are located and are only intended for tourists, while on local islands the Maldivian people live. Today 200 local islands and 100 resort islands exist in Maldives, while the remaining 900 islands are uninhabited. Maldives tourist sector is well-developed and attracts visitors from all over the world for its beautiful white sandy beaches and warm and sunny climate. The tourist sector is one of Maldives highest source of income since it contributes to 27 % of the country's GDP.

### 2.2 Study area: Laamu atoll

Laamu atoll is selected for this comparative case study and the islands that are compared are the local islands Maamendhoo, Maavah and the resort island Six Senses, (see location in figure 2). Laamu atoll is the second largest atoll in Maldives and has approximately 12 000 inhabitants (UNDP, 2013). The atoll consists of 73 islands. 12 are inhabited local islands and one is the resort island Six Senses Laamu, while the rest of the islands are uninhabited. Laamu atoll is one of the poorest atolls in Maldives and people mainly work with fishing and agriculture. Every island in the atoll are exposed to erosion and different islands report an increase in the erosion rate.

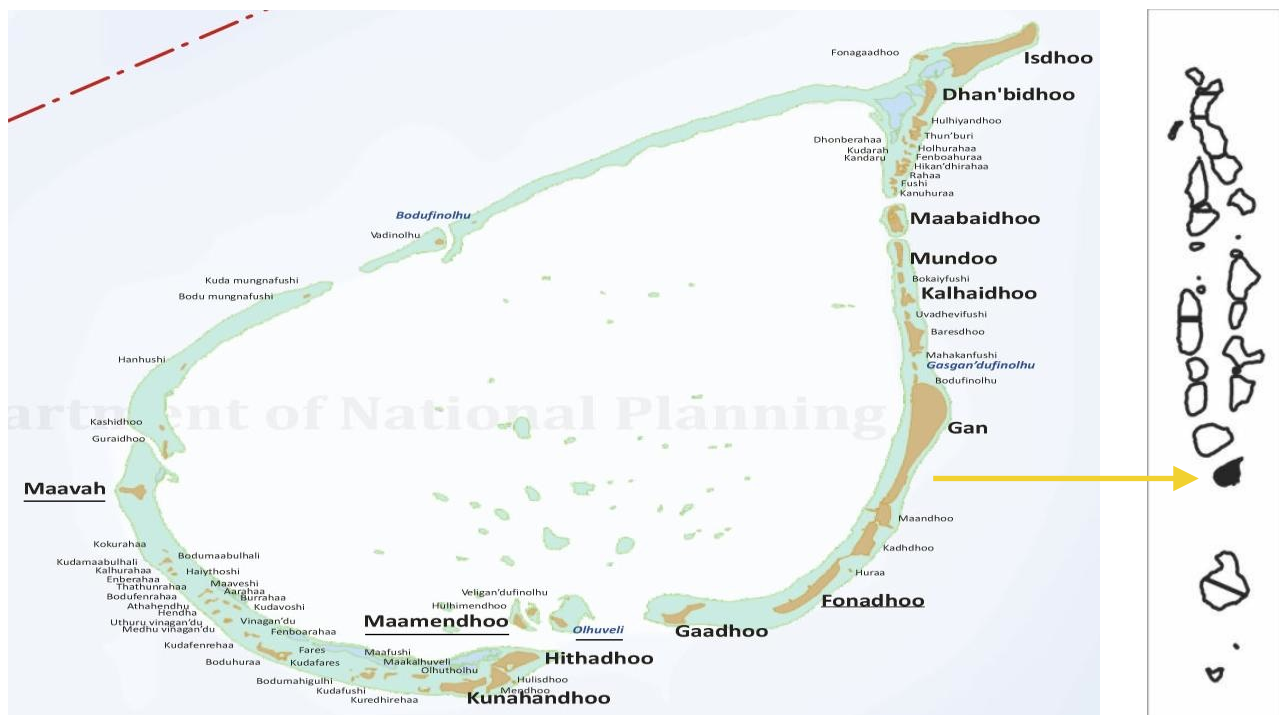


Figure 2. Map of Laamu atoll, located in the south of Maldives. The resort is located on the island Olhuvelli close to Maamendhoo. Maavah is located in the west part of Laamu (UNDP, 2013).

## 2.2.1 Maamendhoo

Maamendhoo is located in the southern part of Laamu atoll, close to the resort Six Senses (see figure 2). Around 1300 people are officially registered residents on Maamendhoo, but only around 900 people permanently live on the island (MaIC, 2014).

Maamendhoo is highly affected to erosion and it is mainly the southwestern and northern parts that are affected to erosion (see figure 3) (MaIC, 2014). Some houses are situated only five meters from the sea (see figure 4). Approximately 60 centimeters/year has eroded close to the police station since 1999 according to a calculation done by the island council (MaIC, 2014). The island counselors express that erosion has been observed the last 30 years. The erosion has according to both local people and the island council increased since the harbor was built in 2009 (Maamendhoo, 2014; MaIC, 2014) and local people also express that the erosion are more common now than 15 years ago (Maamendhoo, 2014). Local people say that there was a lot of sand on every side of the island before and that a lot of erosion happened between the years 2000-2011. The swells are coming up to the roads and house walls sometimes when it is high tide in August, but so far no residential houses or public buildings are affected to beach erosion. Some people say that they have experienced that the sea level has risen and that they are worried about it. They think that the sea level will rise in the future and that heavy storms will come. This will make the erosion more severe which may affect houses near the coast.



Figure 3. Severe erosion on the northwest side of Maamendhoo.



Figure 4. Map of Maamendhoo (MaIC, 2014). The numbers on the map are the houses where local people live that were interviewed for this study. The harbor is located in the northwest part of the island.

## 2.2.2 Maavah

Maavah is located in the western part of Laamu atoll and it lives approximately 1900 people on this island (LAC, 2014a). As shown in figure 6, Maavah is highly overpopulated and there is nearly no place left to build houses on. Some people live only three meters from the coast (see figure 5). The only place with no buildings are the palm forest in the western part of the island. The island is affected by erosion in the northwest and southwest parts of the island, but so far no residential houses, infrastructure or public buildings are affected by beach erosion (MvIC, 2014). The erosion occurs according to local people and the island counselors because of the shifting monsoon (Maavah, 2014; MvIC, 2014) Local people also say that the reasons for erosion on the island is due to the building of the harbor in 2003 (Maavah, 2014). Other reasons are that a strong demand for housing land has led to a decline in vegetation cover across the island, since it has become highly overpopulated (MvIC, 2014). When the vegetation disappears the soil get loose and disappears out into the sea. This problem started in 2007 when the previous island chief gave away land to people close to the coast. Even if this was against regulations, the previous island chief did this to attract votes from people. One local person says that it grew coconut palms six meters from the coastline 20 years ago, but these palm trees have disappeared out in the sea due to erosion (Maavah, 2014). Other reasons for the erosion is that people took corals from the reefs and sand from the beaches to build houses, but this is forbidden today according to Maldivian law. As on Maamendhoo, some people on Maavah are worried about erosion and sea level rise. Some people say that erosion is more common know than 15 years ago and have noticed that the sea level has risen. One example is a person that said that the sea is closer to the house compared with approximately 10 years ago. People are worried that houses near the sea will fall down into the sea in the future.



Figure 5. House located close to the coastline on Maavah.



Figure 6. Map of Maavah (MvIC, 2014).



### 2.2.3 Six Senses Laamu

The resort Six Senses is located on the island Olhuveli (see figure 2), and is the only resort island in Laamu atoll. The building of the resort started in 2007 and it opened in 2010 (SSL, 2014). The resort have overwater villas and a restaurant on poles standing on the lagoon. There are also villas on the island for both tourists and staff. Areas that are most affected by erosion is on the northwest and northeastern parts of the island (see figure 8) (CDE, 2011). Staff on the resort claims that the erosion started on the island when the resort opened in 2010 (SSL, 2014). The natural sand movement around the island ceased and sand started to continuously disappear from affected parts of the island. The resort staff did not know it would become such a big problem when they started to build the resort. According to a report made by CDE Consulting, the erosion and accumulation of sand has been a continuous process since the 1970's (CDE, 2011). Staff at the resort also claims that the beach erosion changes every monsoon (SSL, 2014). In 2011-2101 the resort experienced a heavy storm that to some extent made the erosion severe. The erosion has a great impact on the resort since they have been forced to close down seven villas located near the beach. In the future they are worried that the erosion can affect the whole island.



Figure 7. The resort Six Senses from above.



Figure 8. Map of Laamu atoll and parts of the island that are affected to erosion (CDE, 2011)

## 2.3 Political situation in Maldives

Maldives has experienced an unstable political situation in the country. For 30 years the country has been ruled by the dictator Maumoon Abdul Gayoom, but in 2008 the first democratic election was held in Maldives and Mohammed Nasheed became president (BBC, 2013). In 2011 president Nasheed adopted a Decentralization Act to promote democracy at local level by strengthening both citizens, and local- and regional authorities in governmental decision making (Decentralization-Act, 2010). The governmental system is today divided into national, regional and local level. In accordance with the Decentralization Act the island councils (local authority) and atoll councils (regional authority) was established. Of the 26 atolls in Maldives, 20 atolls has established an atoll council and of the approximately 200 inhabited islands, 68 islands have established an island council (of which two islands have a city council) (CLGF, 2012). In the capital of Malé, the majority of ministries and agencies are located. The different sector ministries are responsible for formulating policies on the national level (UNDP, 2013). Atoll councils are in turn responsible to formulate and implement Atoll Development Plans in accordance with national policies. Island councils have responsibility to formulate and implement Island Development Plans in accordance with the Atoll Development Plans and national policies. The Local Government Authority (LGA) are supporting the different authority levels and help the ministries to have better coordination with the local and regional level.

# 3. Theory (analytical framework)

## 3.1 Introduction

This theoretical chapter provides the reader with an overview and understanding of Wamsler's theory (Wamsler, 2014) which is the framework used to analyze the result in this study and the study of Englund . (2014). Since the two studies use the same theoretical framework this theoretical chapter is shared in both studies. Both of these studies are based on this theory developed by Wamsler (2014), and is used as a theoretical and operational framework to make capacity analyses on how local people, one resort operator reduce risk to the natural hazard beach erosion<sup>2</sup> in Maldives, while Englund (2014) focus on authorities. The theory of Wamsler offer an effective tool for institutions, so that they in a comprehensive and practical way can work with risk reduction (RR) and climate change adaptation (CCA) (Wamsler, 2014). Wamsler has developed four different risk reduction and adaptation measures, (see 3.3.1), so that institutions can develop a more proactive approach in their preparations before, during and after natural hazards occurs. The adaptation measures refer to the adaptive capacity that people and institutions have and the adaptive capacity therefore becomes obvious in the measures that are taken. According to Wamsler institutions can not reduce the potential impact of natural hazards in a comprehensive way without knowledge of the institutions' adaptive capacities. In order to improve the institutions work Wamsler also highlights that these need to get a better understanding of peoples adaptive capacities and how people themselves may reduce the effects of natural hazards. In this way institutions may improve their knowledge about what local people are requesting from the institutions and in turn what their needs are. With this knowledge institutions may therefore develop their risk reduction work so that it complement and support the adaptive capacity of local people.

## 3.2 Background to the theory

This section provides a background description of the theory and gives the reader an understanding of the following section 3.3 Operational framework of Wamsler's theory.

### 3.2.1 Hazards, disasters and risk

Around the world natural hazards<sup>3</sup> are a common phenomenon in people's daily life (Wamsler, 2014). Natural hazards can be divided into two different types: climatic hazards and non-climatic hazards. Some examples of climatic hazards are storms, floods, sea level rise and droughts. Volcanic eruption and earthquakes are examples of non-climatic hazards. A natural hazard can also trigger a so-called secondary hazard, which is a hazard that has been caused by a preceding natural event/hazard. Examples of secondary hazards are landslides caused by rain and coastal erosion enhanced by sea level rise and more frequent storm surge and wave action.

Disasters only occur when natural hazards are combined with vulnerable conditions; that is when people or a system is affected by a disruption and in turn do not have the ability to cope with the human, material, environmental or economic losses and impacts, by using its own resources (UNISDR, 2009). Disaster risk (R) is the probability that this disruption may occur, and is based on the interaction between natural hazards (H) and vulnerable conditions (V) (Wamsler, 2014). This relationship can be explained by the equation:

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<sup>2</sup> The theory of Wamsler can be used to analyze risk reduction to other natural hazards as well.

<sup>3</sup> In addition to natural hazards there are also man-made hazards. Examples of man made hazards are war, crime, terrorism and traffic accidents.

$R = H \times V$ . This means that if a community has the capacity or resources to withstand the hazard, and therefore is less vulnerable, the disaster may not be that severe.

Changing climatic conditions have been observed the last decades and have caused a rise in hazard events (UNISDR, 2012b). This has caused an increase in current vulnerable conditions of people and systems (V) since changes in climate are something that people are not used to handle. The increase in hazard events and vulnerable conditions has in turn increased the number of disasters. This has also been the case with Maldives, which has observed increased precipitation intensity and higher temperatures (MMS, 2014). When a disaster occurs it is a product of previous developments in an area, and can be the root cause that increase the level of risk (Wamsler, 2014). An example is if a country or a region has lacking democratic processes and this can lead to social, economic and political marginalization. As a consequence, it can be difficult for local people and institutions to use efficient responding and adaptive measures when a hazard occurs, and in turn create a disaster. Whether a hazard will result in a disaster is determined by four risk factors according to Wamsler (2014). These are:

1. The type, magnitude, time span and intensity of current hazards and potential hazards in the future.
2. Conditions of the location. In other words how sensitive the location is to withstand current hazards and potential hazards in the future.
3. The existence of usable structures and mechanisms that can respond to current hazards and potential hazards in the future; and
4. The existence of usable structures and mechanisms that can recover from current hazards and potential hazards in the future.

### **3.2.2 Disaster Risk Management**

Disaster risk management (DRM) is a general term for work related to the reduction of risks for disasters undertaken by individuals and institutions, both before, during and after a disaster (Wamsler, 2014). DRM can be illustrated in a so called disaster cycle (UCPH, 2014) which describes its three phases and how the phases interlink with DRM, (see figure 9). The first phase in the disaster cycle is the response phase during and directly after a disaster (Wamsler, 2014). The second phase is the recovery phase, where work is implemented to restore people's former living conditions. The third phase is called development work-phase. This phase aims to improve living conditions for people in the long-term, and do include more aspects than reducing risk from disasters, for example reducing poverty, unemployment, and improve governance structures. This phase continues until a new disaster happens (if a disaster happens). DRM intend to reduce risk in all these three phases and rebuild and develop a society after a disaster. DRM consists of the three different processes; 1) disaster response, 2) disaster recovery and 3) disaster risk reduction (DRR). Disaster response is measures taken to reduce risk during the response phase like saving lives and providing temporary living (UNISDR, 2009). Disaster recovery are measures taken to reduce risk during the recovery phase for instance reconstruct former buildings and restore civic functions like roads, hospitals and schools. Disaster risk reduction are measures taken during all the three phases (Wamsler, 2014). This means that DRR needs to be integrated into the processes of response, recovery, and also development work.

Disaster risk reduction (DRR) and climate change adaptation (CCA)<sup>4</sup> are two areas of knowledge which both aim at reducing the number of incidences and the intensity of disasters (Wamsler, 2014). The differences between the two fields are that climate change adaptation only involves risk reduction to climatic disasters while disaster risk reduction both involves climatic and non-climatic disasters. The access to adequate knowledge and tools regarding DRR and CCA are often lacking amongst authorities, aid organisations and planners (Carmin, Nadkarni, & Rhie, 2012; UNISDR, 2012a; Wamsler, 2009). According to Wamsler it is crucial that both DRR and CCA are essential parts of urban planning and other related government processes, not only after a disaster (disaster recovery) but also before (development work) and during a disaster (disaster response) (Wamsler, 2014). This is one of the reasons why Wamsler developed this theory.

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<sup>4</sup> The definition of adaptation is explained by IPCC as an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." (Parry, 2007)

## Disaster cycle

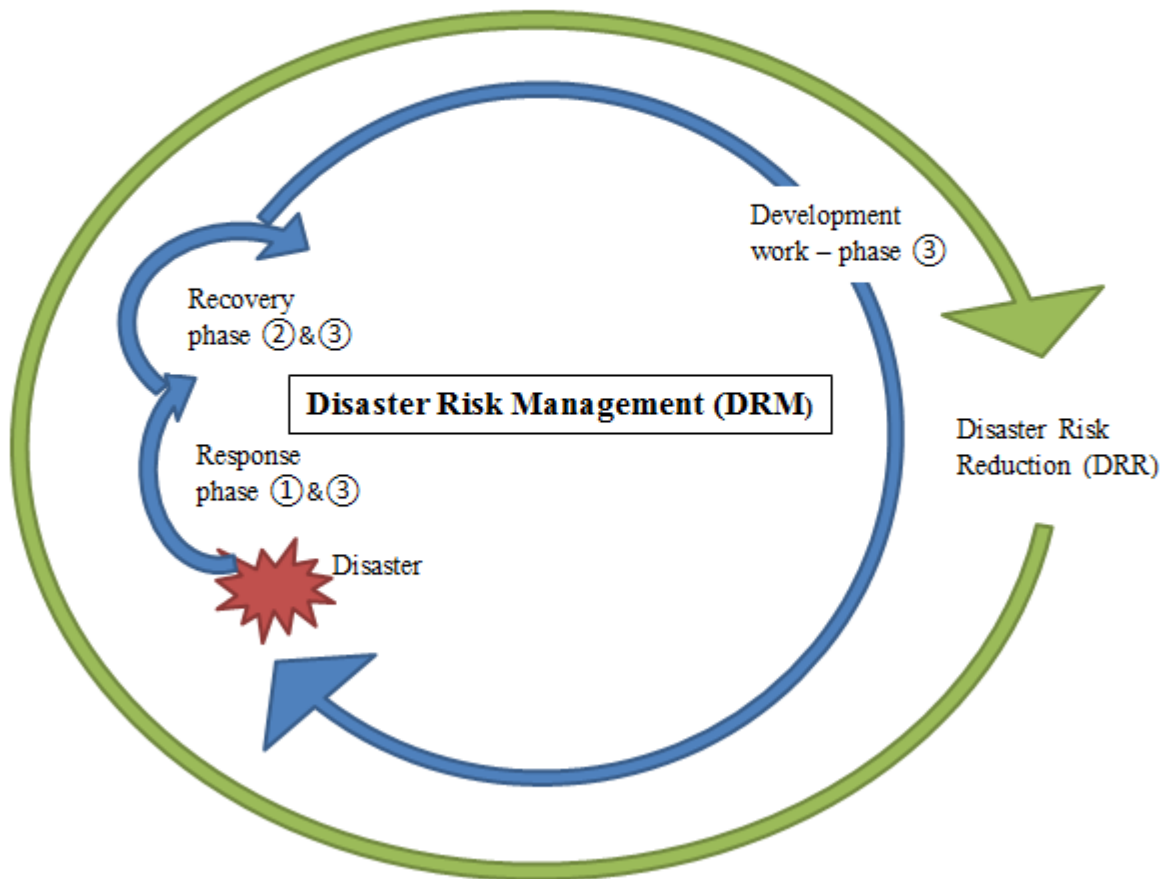


Figure 9. The figure shows how DRM is related to the disaster cycle. The disaster cycle has three phases after a disaster has occurred and to achieve sustainable risk reduction DRR need to be implemented into all phases (UCPH, 2014).

With a successful adaptive work to reduce risk and vulnerability, disasters would not be that severe and reduce the importance of disaster response and disaster recovery.

### 3.2.3. Local communities and people's role in risk reduction

Local people have a big role in reducing risk from hazards since their adaptation work and performance have a great effect when it comes to minimizing the damages when a natural hazard occurs (Wamsler, 2013). In many poor countries there is a need to compensate for lacking governmental risk reduction work. It leaves individuals to take their own initiatives in order to reduce and adapt to disaster risk (Wamsler, 2014).

When institutions are planning for risk reduction the focus is often on physical “hard” measures like a sea wall to protect from sea swells (Wamsler, 2014). These measures are often based on directives that have a top-down approach that does not take into consideration local people's adaptive capacity. Top-down measures can create a false sense of security among locals. It can result in a situation where local people do not become involved, since they believe institutions are responsible for risk reduction.

There are rarely any documentation about what people themselves are doing to reduce and adapt their own risk to hazards (used capacities), and what they can do but do not currently do (unused capacities), (see section 3.3.1) (Carmin et al., 2012; Satterthwaite, 2007; UNISDR, 2012c; Wamsler, 2014). There are hardly any methods or tools to involve local people directly. Peoples exposure and vulnerability to natural hazards are mostly not considered in authorities work (Wamsler, 2014). Local people may not have the impression that they are supported in their work with risk reduction and they may lack information about what they can do to protect themselves and what their responsibilities are.



### 3.3 Operational framework of Wamsler's theory

In this section the operational framework of Wamsler is explained and how the framework is used to analyze the risk reduction and adaptation measures that both individuals and institutions in Maldives use and plan to use.

#### 3.3.1 Disaster Risk Reduction measures

Disaster risk reduction and climate change adaptation include four different kinds of measures that have been developed by Wamsler (2014). They can be planned and undertaken by institutions and/or local people and/or communities before a hazard strike. This may make people and/or the society less vulnerable and more resilient to withstand a hazard. The four measures are built upon the risk factors mentioned earlier (see 3.2.1), which needs to address current and future hazards, and also current vulnerabilities that makes it hard for a location to withstand, respond and recover from hazard impacts. Knowledge about all four risk factors is crucial for institutions to know when analyzing risk and to come up with good and comprehensive measures to reduce the identified risk in an efficient and extensive way. When institutions want to start the work with reducing risk and adapt to a changing climate the first step is to do a risk assessment (Wamsler, 2014). A capacity analysis is a part of every elementary risk assessment (UNISDR, 2012b). Wamsler's four risk reduction and adaptation measures are:

**1) Hazard reduction and avoidance** - intend to increase the capacity to reduce or avoid the level of and/or frequency of current and future hazards that can affect institutions, local people and/or communities (Wamsler, 2014). Local people can for example move from a threatened area to avoid the hazard and institutions can build physical measures, for example a sea wall, to reduce the impact from hazards

**2) Vulnerability reduction** - intend to increase the capacity to reduce the current and/or future vulnerabilities of institutions, local people and communities with the intention to better resist potential future disasters (Wamsler, 2014). For example that individuals stay in the exposed area and try to take measures to improve the situation, for example through building houses at higher elevation or increase the drainage of rainwater in a flood prone area.

**3) Preparedness for response** - intend to increase the capacity to set up good and well organized response mechanisms and structures in a society so that institutions, local people and communities may handle a future disaster in an effective way during and directly after it has occurred (Wamsler, 2014). Preparedness for response measures may for instance be that a country or area have an early warning system if a storm is approaching or that local authorities have standard routines how to act during a disaster occurs.

**4) Preparedness for recovery** - intend to increase the capacity to make sure that recovery mechanisms and structures in a society are easily available so that institutions, local people and communities rapidly can recover after a future disaster event (Wamsler, 2014). Examples of preparedness for recovery measures may be that households have insured their property and authorities give advisory service for reconstruction.

The risk reduction and adaptation measures can be divided into two different contexts: used and unused capacities (Wamsler, 2014). Used capacity refers to the adaptive measures that both local people, communities and institutions currently take to reduce their risk. The capacity becomes obvious in the risk reduction and adaptation measures that are taken, for example the existence of a seawall to protect from sea level rise. Unused capacity, on the other hand, refers to adaptive measures that local people, communities and institutions may take to reduce their risk, but that they currently are not doing. In other words, the capacity to do something to reduce the risk is there, but is not (yet) used. An example may be the existence of a community center which could be used as an emergency shelter. Together used and unused capacity are called adaptive capacity.

In this study and the study of Englund (2014) the operational framework of Wamsler is further developed by adding the context of lacking capacity and planned measures. Lacking capacity refers to measures and capacities local people and institutions do not have. The value of including this context is because it becomes more obvious what local people and institutions can improve and/or what is a limitation in their work.

Planned measures are added to differentiate between measures that have been done and measures that are planned to be undertaken. This gives a wider picture on how the situation looks like and how institutions and local people plan to adapt in the future. By adding lacking capacity and planned measures, the analyze becomes more comprehensive.

### 3.3.2 Capacity analysis

In both studies capacity analyzes are performed, this study is compiling the four risk reduction measures of individuals, and Englund (2014) of authorities. The measures are divided and analysed into past and existing measures (used capacities), planned measures, measures that can be used (unused capacities) and absent measures (lacking capacities). The knowledge from the capacity analyses is used to come up with new potential risk reduction measures or to build upon existing ones to reduce risk in an efficient and comprehensive way. Wamsler means that an effective risk reduction work by institutions, communities and inhabitants needs to be both flexible and inclusive:

1) *Flexibility* means that there is more than one measure that can address each risk factor (Wamsler, 2014). If one measure is not functioning it is good if other measures exist that can be used instead.

2) *Inclusiveness* means that all the four potential risk reduction and adaptation measures are used to guarantee that every risk factor is taken into consideration.

To widen the analysis both studies further categorize each of the four adaptation measures according to their thematic focus; physical, environmental, social, economic, or political/institutional (Wamsler, 2014). This is part of Wamsler's theory, since flexibility also means that there are different types of measures with different thematic focus that address each risk factor. A social measure may for example be how people in a community warn each other before a storm or help each other after the storm. An example of an economic measure may be that households have an insurance that cover the cost of property damage. Categorizing the measures according to their thematic focus makes it easier to make a distinction whether the measures only are focused on specific categories. For example if individuals or institutions only use physical and social measures, and disregard environmental or economic measures. Each measure is color coded depending on its thematic focus. Physical measures are dark grey, environmental measures are green, social measures are red, economical measures are blue and political/institutional measures are orange.

Analyzing the results according to this approach make it possible to find out if any measures are lacking and accordingly determine if the adaptation work among institutions and individuals are adequate or not (Wamsler, 2014).

To get a better understanding of peoples used and unused capacities an in-depth analysis of these risk reduction and adaptation measures are crucial (Wamsler 2014). In this way institutions will improve their knowledge about what local people are requesting from the institutions and in turn what their needs may be. In this way the institutions may improve their relations with the civil society. This analysis may make institutions scaling up, encouraging current coping strategies, and/or proposing new or improved strategies for individuals and communities, where they are required. There is no "one solution fits all", because different factors that contribute to risk may vary within or between cities, settlements and households. The mapping of the four risk reduction measures and their categorization in this study and in the study of Englund (2014) studies are gathered in matrices to make the capacity analyses more comprehensible. The matrices are presented in chapter 5.

# 4. Method

## 4.1 Comparative case study

This is a comparative case study investigating how local people from two islands in Laamu atoll in Maldives are organizing and plan protection measures regarding beach erosion compared to what is done on one resort island. Capacity analyses based upon the method by Wamsler (2014) has been carried out by analyzing which adaptive capacity local people and resorts have to protect themselves from beach erosion problems and threats. The four risk reduction- and adaptation measures (described in chapter 3) can be used as an analytical framework to analyze if the adaptation work among individuals are comprehensive or not. In this report the analyze of the measures taken of individuals have been put into matrixes to find out if they are comprehensive or not. The reason why the capacity analysis from Wamsler was chosen is that she has done research during more than ten years in many countries and with different organizations, where she has developed the four risk reduction- and adaptation measures that are the foundation in the capacity analysis. The main part of her research is available in a newly published book called *Cities, Disaster Risk and Adaptation* (Wamsler 2014).

Further a comparison is made with the result from Englund (2014), which has done similar capacity analyses for authorities in Maldives. This has been done to see how the interaction is between local people/resorts and the authorities.

## 4.2 Pre-study

A pre-study was made by gathering information from important national authorities on Maldives about the situation regarding beach erosion issues. Contact information to the different authorities was collected from the external supervisor Mr. Mihad Mohamed with UDND Maldives. The different authorities were: Ministry of Environment and Energy, National Disaster Management Center (NDMC), Maldivian Department of Meteorology, United Nations Development Program (UNDP) Maldives, Local Government Authority (LGA) and the Maldivian Red Crescent. Totally 13 officials were interviewed, during 9 interviews. One major reason why the pre study was made was to find out which islands to choose for the main study. One other important aspect was to find out how the responsibility regarding beach erosion issues was distributed/allocated between the different authorities. The authority providing the major and most valuable information on adaptive measures undertaken by local people was the Maldivian Red Crescent.

## 4.3 Conversation interviews

This study has also used conversation interviews (depth interviews) to collect information about measures taken to reduce risk from beach erosion on Maldives. It is a qualitative method where an interactive conversation is carried out between the researcher and the respondent. When no new information is given from the interviews, theoretical fullness is achieved and the researcher can determine what the perception is among the respondents. Sometimes two persons were interviewed at the same time, but generally only one person was interview at a time. *Open* and *semi structured* questions have been asked to local people. *Semistructured* questions means that the respondent got different alternatives to choose from, but that they could further develop and express their opinion about it. The reason why semistructured questions were chosen is because the aim is to map out peoples perception about the measures they are taking. People had the possibility to talk about their actions in order to gain a better understanding. When *open* questions was asked, people could say with their own words what their opinion was (Esaiasson, Giljam, Oscarsson, &

Wängnerud, 2007). A number of questions have been asked to every respondent. Before the interviews were held on the islands, interview guides were developed. The questions in the interview guides are based on examples of risk reduction and adaptation measures from Wamsler (2014). The questions that relate to the interaction between local inhabitants and institutions are also based on Wamsler (2014), since she highlights this in her theory. The interview guide was further developed after information from the pre-study and an adaptation survey made by MHE (2011). Some measures were for example taken away from the interview guide, after information from authorities of what local people are not capable of doing. After the interviews on Maamendhoo, the interview guide was updated and new questions were asked to the respondents on Maavah. This means that some of the questions only give information from the respondents on Maavah. The interview guides are presented in Appendix B.

Not only interviews were made to collect information about beach erosion on the different islands. These were compared with our own observations from the islands which were used to get a perception of the situation and measures taken to protect the islands from beach erosion. This empirical information is crucial since this information might possibly not turn up during the interviews.

### **4.3.1 Selection of people to interview**

When selecting people to interview a random sample of 9 people on Maamendhoo and Maavah were used. Both women and men between 17-47 years old were interviewed. They lived 20-150 meters from the sea, so some of the respondents lived more or less in direct contact with the sea, while others lived at some distance. A limitation was drawn only to interview local people that could speak English since it was hard to find an interpreter on the different islands. This resulted in the fact that persons that not always lived close to the sea were interviewed. Only once an interpreter could be found and that was when interviewing a woman on Maamendhoo that spoke not so good English. Even if people lived far away from the sea, they could give information about what measures other people had taken against erosion. The respondents were mostly teachers, but also one student, one computer technician and one council secretary were interviewed and most of the people had lived on the island their whole life. Focus in this study is not on the respondents themselves, but on the information that he/she gives. In this study the aim is to look at how different islands are adapting and not why different respondents answer differently. When selecting people to interview the contact person on both Maamendhoo and Maavah had a great influence on which people to choose, since that person knew many people on the island and which persons who could speak English. In this aspect a snowball technique was used. This technique means that the respondents that the researcher can find can in turn help to find other people who in turn can find other people and so on (Esaiasson et al., 2007). One time a young woman was interviewed who not had been suggested from a contact person, but who was asked directly if she wanted to participate in the study.

The time spent on Maamendhoo was 6 days and on Maavah 5 days. On the resort Six Senses only one day was spent for interviews. On the resort Six Senses the interview was made with the chief engineer, who had a significant knowledge on the measures taken to protect the resort island from beach erosion. Another engineer was also interviewed about the situation on the island.

## **4.4 Selection of study area**

The three different islands to investigate and compare have been chosen after consultation with the atoll councilor on Laamu atoll. The islands that were selected were two local islands called Maamendhoo and Maavah and the resort Six Senses Laamu that is located on the island Olhuveli. The decision to select Maavah and Maamendhoo is based on factors like population, size and erosion situation. Both islands are of small size which characterizes Maldivian islands. An average local island in Maldives has a population of 900 people (UNDP, 2013) and the islands were selected trying to reflect this. The population of Maavah is around 1900 people and around 900 people live on Maamendhoo (LAC, 2014a). Both islands are also exposed to erosion and local people have their property close to the sea. The reason why two local islands and one resort

island where chosen is because Maldives consist of 200 inhabited islands and 100 resort islands and hence makes the selection representative.

The reason why Laamu atoll was chosen for the study is because all the islands of it are exposed to beach erosion. Valuable contacts were also established on Laamu after meetings with the Local Governance Unit and the National Disaster Management Center on Malé. The United Nations Development Program (UNDP) has an ongoing project on Laamu atoll called LeCRED (Low emission and Climate Resilient Development), where information regarding Laamu can be found in their project report (UNDP, 2013), which also was a reason why Laamu atoll was chosen. Another reason why Laamu atoll was chosen is because it is easier to travel between the different islands if they are gathered in the same atoll. The different atolls on Maldives have a large distance from each other. Further, an airport island is established on Laamu (Kadhoo island) and it was therefore easy to travel to the atoll. Not every atoll on Maldives have an airport and the local ferry are a very slow transportation system, since it would take 2 days to travel from Malé to Laamu atoll with the local ferry.

# 5. Result/analysis

In this chapter the result from the interviews with local people on Maamendhoo, Maavah and the resort Six Senses is presented in matrixes (Maamendhoo, 2014; Maavah, 2014; SSL, 2014). Physical measures are dark grey, environmental measures are green, social measures are red, economical measures are blue and political/institutional measures are orange.

## 5.1 Maamendhoo

**Table 1. Matrix showing the capacity analysis of Maamendhoo**

	Used capacity	Planned measures	Lacking capacity	Unused capacity
<b>Hazard reduction and avoidance</b>	<ul style="list-style-type: none"> <li>• Tree planting programs.</li> <li>• Stopped taking sand from beaches.</li> <li>• Built temporary sea walls.</li> </ul>	<ul style="list-style-type: none"> <li>• Move from the island.</li> <li>• Put sandbags on the beach, if permission is given from the government.</li> </ul>	<ul style="list-style-type: none"> <li>• Put sand on the beach.</li> <li>• More economic and material resources are needed. For example big bags and stronger barriers.</li> <li>• People can not plant trees without permission.</li> <li>• People want more information from authorities</li> </ul>	<ul style="list-style-type: none"> <li>• Want to put sandbags in front of houses.</li> <li>• School have interest in working with RR.</li> <li>• Two NGO:s could work with risk reduction, but are currently not doing this.</li> </ul>
<b>Vulnerability reduction</b>		<ul style="list-style-type: none"> <li>• Awareness programs about erosion.</li> </ul>	<ul style="list-style-type: none"> <li>• People are not able to remove their properties or electric cables, because the government owns the land.</li> </ul>	<ul style="list-style-type: none"> <li>• Interest in the community to learn more about how to prevent risk - incentive to have training courses in hazard reduction.</li> </ul>
<b>Preparedness for response</b>	<ul style="list-style-type: none"> <li>• Putting bricks on the beach.</li> <li>• Stay in family house if property get damaged.</li> <li>• Local people call family members and friends that a storm is approaching.</li> <li>• Put temporary sandbags on the beach. (Laamu atoll council, 2014)</li> </ul>		<ul style="list-style-type: none"> <li>• No willingness among local people in protecting the beach from a storm, since the waves will destroy any protection.</li> <li>• No community house available to stay if a persons property get damaged by erosion.</li> </ul>	<ul style="list-style-type: none"> <li>• Community could have a "warning system". Before they used a horn for this.</li> <li>• Could have storage of sandbags to protect the beach before a storm hits the island.</li> </ul>
<b>Preparedness for recovery</b>			<ul style="list-style-type: none"> <li>• No economic capacity for repairing house.</li> </ul>	<ul style="list-style-type: none"> <li>• Interest in buying a insurance for damages caused by beach erosion (no possibility to do this today in Maldives).</li> </ul>

### 5.1.1 Used Capacity

As shown in the matrix above, local people on Maamendhoo are taking measures to prevent damages from beach erosion. These are environmental, physical and socio/cultural measures. People are not using measures regarding vulnerability reduction and preparedness for recovery. The community have build a temporary sea wall (physical measure) of building material, stones from old houses, garbage and trees that is put on the beach on different parts of the island (see figure 11). People have also planted trees (environmental measure), that has been initiated by both the previous government and the island council. When the island council



Figure 10. Palm trees planted by local people.



Figure 11. Temporary seawall

initiated to plant trees, schoolchildren and teachers helped to plant them. People have also planted palm trees on the island, and was initiated by themselves (see figure 10). People also do not take sand from the beach and have not done that the last 15 years since there is a government rule that has prohibited this. People took sand from the lagoon before, but have stopped this also.

When a storm is approaching people call each other on the island and also nearby islands (socio/cultural measure). According to Laamu atoll council, people will put temporary sandbags on the beach if a storm is approaching. The sand is taken from nearby uninhabited islands. The used capacity of local people is measures related to hazard reduction and avoidance and preparedness for response. This means that the *inclusiveness* of all risk reduction and adaptation measures are lacking on Maamendhoo. Inclusiveness means that all the four potential risk reduction and adaptation measures are used to guarantee that every risk factor is taken into consideration (Wamsler, 2014). When it comes to *flexibility* which means that it exists more than one measure that can address each risk factor, this is the case regarding hazard reduction and avoidance and preparedness for response.

### 5.1.2 Planned measures

The measures that people said they are planning to do are physical and socio/cultural. One person said that he would move from the island if support is given from the central government. The reason is not only because of erosion, but also because of better health facilities on other more developed islands. One person said that she will hold awareness programs that will be about the damages of beach erosion, and how people can protect themselves.

### 5.1.3 Lacking Capacity

The capacity that people is lacking are economic, physical, political/institutional and environmental. People are not allowed to plant trees without permission from the island council since the government has a rule about this. There is no willingness in protecting the beach according to one person. When a storm is coming, the sea level is very high, and beach is at a low level so if people put something on the beach the waves will hit land anyway. People cant build something that is big enough to protect when there comes a storm. One person does not think she would get assistance from the government reconstructing her house if it gets damaged by beach erosion.

### 5.1.4 Unused Capacity

The unused capacity that people potentially might use is mostly socio/cultural, but also physical and economic. People have asked the island council to put sandbags in front of their house but the island council did not get permission from the Ministry of Environment and Energy. According to a teacher on Maamendhoo, the school have interest in working with risk reduction, for example to control and monitor the

development of beach erosion on the island. The problem is that they do not have enough economic resources for this and would need finance.

## 5.2 Maavah

**Table 2. Matrix showing the capacity analysis of Maavah.**

	Used capacity	Planned measures	Lacking capacity	Unused capacity
<b>Hazard reduction and avoidance</b>	<ul style="list-style-type: none"> <li>Plant trees (Hirúndhu and coconut palms)</li> <li>Built sea wall of round shaped cement blocks filled with sand</li> <li>Built temporary sea walls.</li> <li>Put corals on the beach.</li> <li>Do not take sand from the beach.</li> <li>Refill ditches with soil and sand</li> <li>Built a concrete revetment made of sand cement bags.</li> </ul>	<ul style="list-style-type: none"> <li>Move to safer place where land is available.</li> <li>Planting more trees</li> <li>Aware the community not to take sand from the beach.</li> <li>Refill small parts along the coast with soil and sand.</li> </ul>	<ul style="list-style-type: none"> <li>Can not build sea wall, breakwaters and revetments without permission from island council and an EIA.</li> <li>Do not have economic capacity to protect from beach erosion. Need finance from the government.</li> <li>Do not have knowledge about how the measures will decrease erosion and how it will affect other parts of the island (negative side effects).</li> <li>Did not get approval to do land reclamation after the harbor was built.</li> </ul>	<ul style="list-style-type: none"> <li>Currently teaching causes and reason for erosion in environmental studies. Can be upscaled to include how people can prevent erosion.</li> <li>Interest among younger people to learn other people about risk reduction.</li> <li>Want information on how to build good protection and how to avoid negative side effects from government.</li> </ul>
<b>Vulnerability reduction</b>	<ul style="list-style-type: none"> <li>People have enhanced the house foundation.</li> </ul>		<ul style="list-style-type: none"> <li>Most people believe the government will do everything. They don't take initiatives to create an organization that could work with risk reduction of beach erosion.</li> </ul>	<ul style="list-style-type: none"> <li>Interest to participate in a community initiative to monitor the erosion.</li> <li>NGO (not functioning now) that have put net on the beach and moved material from one place to another with physical help from the police. This could be done again.</li> </ul>
<b>Preparedness for response</b>	<ul style="list-style-type: none"> <li>Put sand around the house, taken from nearby islands.</li> <li>Disposal of sandbags to temporarily protect from erosion (mainly for flooding)</li> <li>Stay at relatives if house will be damaged by erosion.</li> <li>Predict that a storm is approaching by the color, size of clouds and changing temperature.</li> <li>People warn each other when a storm approaches. For example by calling and knocking on neighbors door.</li> <li>Parents do not let children go out.</li> </ul>			<ul style="list-style-type: none"> <li>Schools might provide a place to stay if people's houses are damaged by erosion.</li> </ul>
<b>Preparedness for recovery</b>	<ul style="list-style-type: none"> <li>Would be able to repair damages on property caused by erosion with the help of other people.</li> </ul>		<ul style="list-style-type: none"> <li>Low income that make people vulnerable and not able to repair damages on their property caused by erosion.</li> </ul>	<ul style="list-style-type: none"> <li>Interest in buying insurance that cover damages caused by erosion. Today only fishing boats are insured (not buildings)</li> </ul>



## 5.2.1 Used Capacity

On Maavah people have taken measures that are physical, environmental and socio/cultural but not economic or political/institutional measures. Since the island do not have any waste management system people are forced to throw garbage and waist building material along the coast. The garbage works as a temporarily sea wall to protect from erosion. People have also put temporary sea walls of trees, stones and nets to minimize the movement from the currents. These temporary sea walls are located on different parts of the island and the incentive often comes from grandparents. People in general say that older people have more knowledge. People do not buy anything but only use leftovers. People help each other with this. On the north side of the island people in 2008 have built a seawall made out of round shaped cement blocks filled with sand to protect their own homes (see figure 12). The sea wall is 1 meter in diameter and the people financed it by themselves. The same year (2008) a concrete revetment made of sand cement bags was also done by a local group outside the football ground since the erosion was severe there. The incentive was taken by the local island development committee and they asked for help to the government who also assisted with financial support. The revetment is still there, but it is covered with new sand. Generally people do not take sand from the beach. Unfortunately some people still do it, despite it is against Maldivian law to take sand from inhabited islands.



Figure 12. Temporary sea wall of garbage, trees and round - chaped cementblocks.

Local people plant trees from branches that is initiated mostly by grandparents. People plant the trees with branches since it will take shorter time for the tree to grow, compared if the tree is planted with seeds. They do not buy branches, but take it from other trees. In 1997 the previous NGO on Maavah planted trees two times on the island. Previously people got financial support from the government to cut trees down, but now that system has stopped. This has resulted in a situation where people do not get incentive to grow and cut trees down in the same amount as they did when the system was still existing.

People may by traditional knowledge predict that a storm is approaching by the color and size of clouds. Mostly elderly people have knowledge about this and use a calendar that is divided into 14 parts. The calendar is changing now because of climate change and people find it harder to predict the weather.

On Maavah all the risk reduction and adaptation measures are represented, which means that the inclusiveness of all measures are there. But if you look at flexibility, which means that it exists more than one measure that can address each risk factor, only one measure could be found regarding both vulnerability reduction and preparedness for recovery. This means that if one of the measures by some reason will not function, there are no other measures that could be used instead.

## 5.2.2 Planned measures

The planned measures that people want to do are physical, environmental and socio/cultural. Some people want to move to a safer place if land is available on other islands. People will also refill sand and soil in the future at places where it has been washed away. It is only possible to do this over small areas and only limited of amount of refilling ca be done..

## 5.2.3 Lacking Capacity

Capacity that people are lacking on Maavah are physical, political/institutional, economic and socio/cultural. For preparedness for response, no lacking capacity was found from the interviews. The main problems are that people do not have economic resources to build lasting protection and that they lack knowledge about measures they can take and how it will affect erosion. There is also a problem obtaining a permission to initiate measures, since people are forced to do an Environmental Impact Assessment (EIA) if they want to do for example a breakwater. It is very expensive to do an EIA and that is why people can not take the measures.

Before the decentralization people did not need permission for this. People have to first ask the island council who in turn ask the Environmental Protection Agency (EPA) for permission. People have also asked the authorities to do land reclamation when the harbor was built, but this was not done.

### 5.2.4 Unused Capacity

The unused capacity on Maavah are political/institutional, economic, socio/cultural and physical. Young people are interested in how to prevent risk which could be an incentive to have workshops in hazard reduction with teachers in school.

## 5.3 Six Senses

Table 3. Matrix showing the capacity analysis of Six Senses

	Used capacity	Planned measures	Lacking capacity	Unused capacity
<b>Hazard reduction and avoidance</b>	<ul style="list-style-type: none"> <li>Planting of palm trees 4 times/year</li> <li>Do not cut trees down.</li> <li>Beach nourishment</li> <li>Breakwater - geotubes.</li> <li>Seawall made of sand cement bags.</li> <li>Follow the recommendations in the EIA (Environmental Impact Assessment) when the jetties were built to prevent beaches from getting eroded by building break walls.</li> </ul>	<ul style="list-style-type: none"> <li>More geotubes</li> <li>Plant more trees</li> <li>Beach nourishment</li> </ul>	<ul style="list-style-type: none"> <li>Want to have tetrapods (but do not have enough money to do it)</li> </ul>	
<b>Vulnerability reduction</b>	<ul style="list-style-type: none"> <li>Construct buildings so that it can withstand erosion - poles with 1,5 m high elevation.</li> <li>Ensure that builders are experienced from other resorts that have problem with erosion.</li> <li>Removed part of the room in one house. Also removed electric cables and sewage pipelines - they have a post in the budget for this purpose</li> </ul>			<ul style="list-style-type: none"> <li>Interest to learn more about risk reduction which could be an incentive to have training courses in hazard reduction.</li> </ul>
<b>Preparedness for response</b>	<ul style="list-style-type: none"> <li>The resort call nearby islands that a storm is approaching, and the guests on the resort.</li> <li>Disposal of sandbags to be able to temporarily protect from erosion.</li> </ul>		<ul style="list-style-type: none"> <li>No place to stay if the resort will be damaged by erosion.</li> </ul>	
<b>Preparedness for recovery</b>	<ul style="list-style-type: none"> <li>Know how to repair wastewater pipes to reduce risk of environmental contamination</li> <li>Know how to repair sea walls and revetments</li> <li>Know how to refill sand that has been removed.</li> <li>Weekly meeting to get updated about precautions to take after beach erosion has occurred.</li> <li>Insurance that cover damages caused by beach erosion.</li> </ul>			
<b>Other measures</b>	<ul style="list-style-type: none"> <li>Monitor and control the development of beach erosion. Take photographs every day and have a stick in the ground.</li> </ul>			

### 5.3.1 Used capacity

The used capacity that the resort Six Senses have are physical, environmental, economic, socio/cultural and political/institutional, which means that all the different thematic focus are being used. The resort has three years of experience from beach erosion, which they have gained after the erosion started in 2010. To gain

knowledge about measures the resort can do, they have contact with other resorts that also have problem with erosion. They finance all the measures taken by themselves and estimate in their budget that the cost for beach erosion is 100 000 US dollar/year. The resort has hired a consulting company called Seamarc that works with erosion problems. Six Senses first went to EPA about their problems, that in turn told them to contact Seamarc. Seamarc have done a consultation and a report about how severe the erosion is on the island and what measures that might be taken to stop the problem. In 2013 Seamarc installed 3 geotubes that work as breakwaters since sand is accumulating behind them - a tombolo formation - (see figure 13). They need permission for this. Further measures the resort need permission for is to pump sand to the beach from the lagoon and a sandbank. The resort have also planted palm trees 4 times/year with the help of school children from Maamendhoo and Hithadoo.



Figure 13. Geotubes installed by Seamarc



Figure 14. Sea wall of sand cement bags

The resort have done a sea wall made of sand cement bags in 2013, since the erosion was so severe that the kitchen building was next to the sea (see figure 14). According to the resort they did not need permission to build this sea wall. 30 persons from Bangladesh have been hired to move sand from another beach to this part.

When buildings on the resort are constructed they construct buildings on poles with 1,5 m high elevation. In the beginning they did not concern about this, but when the problem with erosion started they began to consider this. The resort has three years of experience and they have contact with some other resorts today.

Six senses adaptive work have both flexibility and inclusiveness.

### 5.3.2 Planned measures

Measures that the resort plans to do are physical and environmental. The resort plans to install 12 more geotubes. They also want to plant more trees and do more beach nourishment. The aim is to make a new beach that is 10 meter long.

### 5.3.3 Lacking capacity

Capacity that the resort is lacking are physical and economical. The resort would like to have tetrapods, but do not have enough money for this. The resort also does not have any other place to move their guests or staff to if the houses will be damaged by erosion during a storm.

### 5.3.4 Unused capacity

The only unused capacity that is found from the interview is that there is an interest to learn more about risk reduction which could be an incentive to have training courses in hazard reduction. Since the resort already does so much regarding beach erosion, they have used much of their capacity already.

## 5.4 Interaction between local people/resorts and the authorities

This section deals with research question number three in this study and the study of Englund (2014). The authorities perspective are gathered through interviews with officials and councils at all authority levels and the local people's and the resort's perspectives through interviews with people at Maamendhoo and Maavah and staff at Six Senses Laamu.

### 5.4.1 Responsibility of authorities

The first analysis deals with the perception and opinion of the local people and staff of the resort Six Senses. What do they think that authorities should do against beach erosion problems and how does this compare with the opinion of the authorities?

Local people on both Maavah and Maamendhoo think that the responsibility of the national authorities are to take protection measures against erosion, like making barriers and putting big bags around the island etc., and they further think that the authorities have resources to do this (Maamendhoo, 2014; Maavah, 2014). People on Maamendhoo want the government to give financial support, which they currently are not doing (Maamendhoo, 2014). MEE has the main responsibility for the national planning regarding erosion and they take the initiative if coastal protection measures needs to be done (EPA, 2014; MEE, 2014a). In turn it is MHI that does the physical work to build the coastal protection measures, and also initiate the EIA (MHI, 2014a). EPA is responsible to investigate if the EIA regulations are followed. They also have a priority list of which islands that are in need of erosion protection (EPA, 2014). The MEE:s official thinks that they have enough knowledge about erosion, but the financial resources are lacking that is the key problem preventing them from doing their work in a proper way (MEE, 2014b). MHI think that they are short on staff (MHI, 2014a, 2014b). The engineering section does not have any coastal engineer at the moment (MHI, 2014a). It is difficult to keep the staff because the private sector and other actors pay more than MHI can.

Local people on Maamendhoo also think that MEE and EPA should hold awareness programs about the situation (Maamendhoo, 2014), while people on Maavah think this is something the island and atoll council should do (Maavah, 2014). People on both islands want to have more information about erosion and how it can be prevented by building good protection, and also about how different measures affect different parts of the island (negative side effects). Local people can then manage it better on their own. Laamu atoll council has carried out awareness campaigns on different islands in Laamu atoll during the last mandate period (LAC, 2014). The awareness campaign was about environmental issues including beach erosion. MEE and EPA has also carried out awareness campaigns in different parts of the Maldives to community NGO:s, school children, environmental groups and island officials (MEE, 2014a; EPA, 2014). Unfortunately it is not known if this has been done on Maamendhoo or on Maavah. Both Maamendhoo and Maavah island council plan to carry out environmental awareness campaigns to local people that include erosion (MaIC, 2014; MvIC, 2014). Maavah island council says that they currently try to make people aware of the erosion problems but that they not officially are working with it (MvIC, 2014).

On Maavah people think that the national authorities have the responsibility to make laws and guidelines that people should follow (Maavah, 2014). For example not to take sand or not to cut down trees. In Maldives it is MEE that develops policies regarding erosion and implementation of erosion projects (EPA, 2014, MEE, 2014a). MHI are in turn responsible for the development and implementation of land use plans and development plans guidelines (MHI, 2014a). When MHI develop plans they do consultations with the locals and try to include and implement their opinions. MHI and island councils have to consult with the island community like women's committee, island council, NGOs, education health and power utilities during the development plan process.

Local people on Maavah think that the island council will not do anything to prevent erosion if they are not interested (Maavah, 2014). That is why it is important with laws and guidelines that the island council need to follow and that it is the island council's responsibility to enforce the laws. For example by contacting the police who will fine if people take sand from the beach or corals from the lagoon. The island council on Maavah also think that this is their responsibility (MvIC, 2014), but this process can be more effective than

what it is today, according to people (Maavah, 2014). Although some people think that it starts with the island council and that it is the island council that need to ask for help to the national authorities, otherwise nothing will happen. In sum local people on Maavah want the authorities to have better coordination between each other, so that the work becomes more effective.

People on both Maamendhoo and Maavah think that the island council has a responsibility to protect the beach from erosion (Maamendhoo, 2014; Maavah, 2014). For example to construct barriers and to carry out proper monitoring of beaches and investigate which sites that are commonly eroded. They should also investigate which houses that are affected and make people aware of the situation. Both Maamendhoo island council and Laamu atoll council state that their responsibility is to work for and to take measures to reduce the erosion (LAC, 2014a; MaIC, 2014). This therefore harmonize with the perception of what local people think they should do, even if they do not have financial resources to implement these measures and need support from the government. Laamu atoll council has mentioned erosion measures in the previous atoll development plan and send it to the government for implementation (LAC, 2014a).

Maamendhoo island council thinks they do not cooperate yet with people in the local community regarding erosion measures (MaIC, 2014). Still, local school children helped the council to plant trees in 2012. If the council asks the locals for support they are sure they will help.

People on Maavah also want the island and atoll councils to do a survey around the island to find out how fragile the environment is and to monitor which houses that are affected to erosion (Maavah, 2014). EPA is responsible for monitoring erosion changes, but has not done this on Maavah. They have done a survey on Maavah that includes beach erosion (MvIC, 2014; EPA, 2014). Sometimes EPA gives presentations about their current work or the result of a technical survey on request from schools, NGOs or governmental authorities (EPA, 2014). It seems like this has not been the case on Maavah, since people in general do not have information about this survey.

On both Maamendhoo and Maavah none of the respondents believe that the authorities are doing enough to prevent erosion (Maamendhoo, 2014; Maavah, 2014). Some persons on Maamendhoo do not even trust politicians, since they have not done anything the last 4-5 years. On Maavah people say that the central government does not take any measure to prevent erosion. Although people on both Maamendhoo and Maavah understand that national authorities do not have enough resources to help all of the 200 inhabited islands in Maldives, since nearly all islands have the same situation with erosion.

Six Senses think that the responsibility of the national authorities are to make surveys and help them with monitoring the erosion situation (SSL, 2014), which EPA also have responsibility for (EPA, 2014). Further the resort's opinion is that the responsibility of the authorities is to give financial support to the resort (SSL, 2014). The Ministry of Tourism is responsible for the development and implementation of regulations and guidelines for the tourist sector including beach erosion regulations (MT, 2014). The ministry also approves resort operators' development plans before the resort is built and when it is constructed they make sure the regulations are followed. If not the resort is not allowed to open. Since the atoll and island council do not have any responsibility when it comes to resorts, no question was asked to the resort about the responsibility that the atoll and island council have. On Six Senses they could not say whether the national authorities are doing enough to prevent erosion, since they need to evaluate whether the measures they have helped them with are satisfying (SSL, 2014). If they need more help in the future they will ask for it.

#### **5.4.2 Responsibility of local people and resorts**

The opinion of national, regional and local authorities regarding the responsibilities that the local people and resorts should have to take precautions against beach erosion is here presented and compared with what local people on Maavah and Maamendhoo and staff at Six Senses think about their own responsibility.

According to MEE and EPA the local people are responsible to report to their respective island and atoll councils if they are exposed, and then the councils should report upwards to the national authorities (MEE, 2014b; EPA, 2014). MHI thinks that locals have a social responsibility to be aware of how erosion occurs and follow national regulations (MHI, 2014a). One official at EPA thinks locals do not have more responsibility than report to the authorities (EPA, 2014). According to the official it is the authorities at all levels that have

the responsibility to take coastal protections on the islands. EPA does not think the locals live up to their responsibilities since they almost do not get any reports. This is probably because the locals do not have knowledge of who they should report to and then contact the local councils in the first place.

The regional and local authorities have different views of how much responsibility local people have to prevent their beaches from erosion. One atoll councilor and the island councilors on Maamendhoo think the locals have more responsibility than national authorities (LAC, 2014b; MaIC, 2014). They think locals should follow national regulations and that they also should protect their property and themselves as much as they can by for example enhancing their house foundations. The island councilors at Maavah island council think the locals should follow national regulations and tell the council or the police if they see someone breaking these regulations (MVIC, 2014). The second atoll councilor thinks the locals have responsibility to prevent from beach erosion but that the authorities have the main responsibility (LAC, 2014a). According to the regional and local authorities the local people do not fully live up to their responsibilities because a few still take sand from beaches and corals from the reef and some houses have weak constructions. One councilor at Laamu atoll council believes everyone has responsibility to prevent erosion, both authorities and citizens, but means that most of the responsibility lies with the authorities (LAC, 2014b).

In accordance with the atoll councilors perception, the local people on Maamendhoo and Maavah think that everybody have responsibility to prevent erosion (Maamendhoo, 2014; Maavah, 2014). They also agree with the authorities that their responsibility is to follow national regulations like not take sand from the inhabited islands and corals from the reef. One person on Maamendhoo states that people have the responsibility to tell each other what to do and not to do in order to prevent erosion and that locals should take away the garbage from the beach (Maamendhoo, 2014). On the other hand one person on Maavah thinks people should not clean the beach from garbage since the person think it will worsen the erosion situation (Maavah, 2014). Even though some of the interviewed on Maavah think local people have responsibility to take precautions for beach erosion, some people say that they are busy with other things and do not have the time to take precautions.

Resort islands need to apply to EPA for permission to take physical measures (EPA, 2014.) One official at MT think that resort companies have to make sure they do not break the tourist sector's regulations regarding beach erosion (MT, 2014). The official thinks the resorts live up to their responsibilities very well. It is only occasionally that resort operators do not follow guidelines and regulations because many of the operators are from abroad and is not aware of all national regulation of Maldives. The staff at Six Senses does not mention anything about following regulations, they think they are responsible to protect their island because they are dependent on a good looking beach to attract guests to the resort (SSL, 2014).

### **5.4.3 Hindering or supporting?**

The opinion from the authority level regarding if local people and resorts are hindering or supporting the authorities work regarding beach erosion is presented here. The interviewed officials and councilors answers are compared with opinions from local people on Maavah and Maamendhoo and staff on Six Senses Laamu regarding if the authorities are hindering or supporting their work.

Local people do not believe that the authorities are supporting their work, instead they think they are hindered by laws (Maamendhoo, 2014; Maavah, 2014). According to the interviewed locals it was easier to get permission to take physical measures before the island council was established in 2011 than it is now. The reason is the EIA regulations. Before any physical measure is undertaken along the coast an EIA has to be carried out. The problem is that people do not have any money for doing an EIA. EPA expressed during the interview that they get complaints from island councils, resort and locals since they are perceived stopping the development when an EIA is needed in all type of development projects (EPA, 2014). Occasionally EPA also meets resistance because people are afraid of changes.

When the construction of the harbor on Maavah was carried out in 2009 people said they could say their opinion about it (Maavah, 2014). One person said that MHI did not follow the recommendations, since they changed their work. When the EIA was done MHI said the harbor would not damage and increase erosion,

but according to some people the erosion became worse after the harbor was built. People only think that authorities are supporting if houses are damaged.

To compare with the authorities opinion if local people are hindering or supporting the authorities work, all of the authorities say that local people are generally supporting them. According to MEE, locals are not hindering the ministry because MEE is working for the benefit of them (MEE, 2014b). The locals participate in meetings and have their opinion about MEEs erosion projects. Even if they do not agree about MEEs project it is not hindering according to the interviewed official. The same opinion is found among one official at MHI since local people show up during community consultations in the EIA process and are interested of what is best for their island (MHI, 2014b). MHI means that local islands often have a high level of community sense. If there are people giving resistance the island councils would stop them or explain to them how things should work. But MHI try to meet their views and needs. One common problem is often lack of land, and locals prefer to have bigger residential lots but do not complain because of their strong community sense, one MHI official means. People know it is done for their benefit. Maamendhoo and Maavah council experience that most people are supporting them and appreciate what the councils do regarding their work with erosion (MaIC, 2014; MvIC, 2014). One reason is that the locals follow the regulations not to take any sand from the beach and not cut down any trees. There are a few people hindering the councils' adaptive work by not follow the rules and they are reported to the police. One council also said some locals refuse to follow the council's decisions due the councilors' political affiliations.

Staff at Six Senses have the opinion that the authorities are supporting the measures the resort takes against erosion (SSL, 2014). The official at MT states there is no hindrance against the ministry's work because it will harm the resorts financially (MT, 2014). All resort properties are insured but if the resort operators do something against the guidelines and regulations the insurance does not cover potential damages.

#### **5.4.4 Complementing or not complementing each others adaptive work?**

This section is comparing the different matrixes from the capacity analyses regarding both what local people, Six Senses and authorities are doing to reduce risk against erosion (see chapter 5 and Appendix A). This is done to see how they are complementing each others adaptive work.

The Maldivian authorities are sometimes complementing local people's and Six Senses's risk reduction initiatives and sometimes not. One example where they are complementing each other is that one local person on Maamendhoo expresses that he would move from the island if support is given from the central government (Maamendhoo, 2014). This is complementing the authorities work because the central government is currently working on reducing the number of inhabited islands (MMS, 2014) by enlarging six islands through land reclamation (MHI, 2014a). They try to attract people moving there by offering better facilities and more spacious living. Another example is that local people on Maamendhoo have planted trees that have been initiated by both the previous government and the island council (Maamendhoo, 2014). Six Senses's risk reduction work is complementing the authorities risk reduction work because the resort operator has taken several measures within all categories except preparedness for response. The authorities have not taken any vulnerability reduction measures or preparedness for recovery measures at all on Six Senses Laamu. They are also complementing each others work since the authorities are giving Six Senses permission to take all measures the resort is asking for. Comparing the result from the capacity analyses regarding both Maavah and Maamendhoo it shows that local people take more measures when it comes to preparedness for response measures compared to what authorities do. On Maavah, local people also have one vulnerability reduction measure and one preparedness for recovery measure while the authorities do not have any of these measures. This shows that local people are complementing the authorities gaps/weaknesses in their adaptive work.

There are cases when local people are not complementing the authorities adaptive work regarding beach erosion. For example that it is regulated in Maldivian law that no one is allowed to take sand from beaches on inhabited islands and take corals from reefs (MvIC, 2014). The regulation is followed by most people, but few people still take sand and corals. Another example is that Maamendhoo island council has forbidden to plant palm trees close to the coast to reduce size of land chunks lost to erosion (MaIC, 2014), but the locals do this anyway. By comparing the authorities capacity analysis and the local people's capacity analysis for



Maamendhoo it appears that none of them have taken any used measure in the categories vulnerability reduction and preparedness for recovery. This shows that their risk reduction work do not complement each other and therefore the authorities needs to develop these kind of measures more than others.

#### **5.4.5 Adaptive help from authorities**

One local person on Maamendhoo have asked Maamendhoo island council to put sandbags on the beach to protect a house (Maamendhoo, 2014). Since the island council does not have enough economic resources they send a letter to EPA regarding this matter and asked for permission two years ago (MaIC, 2014). The agency has not yet replied. The official at EPA experience that the agency has the knowledge but has limitations in staff, funding and equipment (EPA, 2014) which can explain why Maamendhoo island council has not got any reply. The councils on both Maamendhoo and Maavah express they cannot accomplish their mandate in accordance to the Decentralization Act because they experience the power is still centralized. Both Maavah and Maamendhoo island councils also think they do not have enough resources and knowledge to protect the island against beach erosion (MaIC, 2014; MvIC, 2014). More educated staff is also required to implement the erosion protection measures and so that they can develop their own land use plans.

On Maavah people have asked for help to refill sand (land reclamation) after the construction of the harbor, but this has not been approved according to people (Maavah, 2014). One example where people have got help from the authorities is when a sand/cement bag revetment was built on Maavah in 2008 and financial support was given from the government. According to a local person on Maavah the central government have granted people money for damage on property on and they have sent a letter to find out how many houses on the island that are affected by the erosion. People that have not asked for help said that if they will face damage, they will first contact the island council, who will contact further to national authorities. This corresponds to what EPA is saying, since they are mostly in contact with the island councils instead of local people (EPA, 2014).

Six Senses has asked for help to EPA to do a survey about the erosion situation, which EPA also have done (SSL, 2014). EPA has also helped Six Senses to get in contact with the consult firm Seamarc that have helped the resort to install geotubes. The national authorities share their ideas with the resort. MT and MEE are for example giving reports and information about improvement the resort can do. According to the official at the MT they are in most cases able to give help if a resort is asking for it, since they do not lack financial capacity to do their job regarding beach erosion (MT, 2014). The person means that the ministry is able to produce good practice, guidelines and prepare for incidences. Within the ministry they have expertise and consultants available for the resorts to seek for help to get technical advice and solutions for that specific island. But the ministry does not have capacity to visit resort islands as often as they wish.

The resort has cooperated with the previous atoll councilor by phone two times/month. The atoll councilor has also visited the island to see how the situation regarding erosion is on the resort. The atoll council assist the resort by for example reporting to the central government that the resort have problem with beach erosion (SSL, 2014). The current atoll councilor says that Six Senses has never asked the atoll council for help regarding erosion (LAC, 2014b). But the current councilor have only had his post a short period of time, which means that they may continue help the resort with these matters in the future. Although, both of the councilors do not think the atoll council is able to give help to limit damage due to beach erosion if a resort asks for it because they do not have enough budget (LAC, 2014a; LAC, 2014b).

The general perception among people on both Maamendhoo and Maavah is that they will get help from national authorities in the future if the erosion damages houses and harm people (Maamendhoo, 2014; Maavah, 2014). Some people were not sure exactly what kind of help they will get, or if they will get help from national authorities, but their hope is that they will get help from authorities in the future. People on Maavah say that since the national authorities helped during the tsunami, they believe that they will help again if the erosion gets severe (Maavah, 2014). Although some people on Maavah think that they will only get help from the island council and not national authorities. One person on Maamendhoo has a different opinion and says that it is only the government that can do something, and not the island council, since there are lacking economic resources (Maamendhoo, 2014).



Unfortunately the question regarding if the resort think they will get any help in the future from authorities was not asked to Six Senses.

#### **5.4.6 How authorities in Maldives inform about their current work**

This section describes how authorities inform about their work to local people and the measures they are planning to do.

According to the two island councils they think they have not done anything to prevent beach erosion and has therefore not informed about their work in any way (MaIC, 2014; MvIC, 2014). If they inform about their work in the future they will inform on Facebook, and on a note board outside the island council building. They have informed about the harbor this way. In the future Maavah island council plans to carry out a tree project (MvIC, 2014). Then the council plans to publish it before the project and arrange activities around it.

MEE does not inform the local people about their current work to reduce risk to beach erosion more than the awareness campaign and putting up information on their website about ongoing projects (MEE, 2014b). The projects are also published in local media and magazines where the project is carried out. MHI and EPA does not inform about their work regarding erosion to local people. (MHI, 2014b; EPA, 2014).

The national authorities do not contact resorts about measures. Since resorts have the main responsibility to take measures against beach erosion Six Senses hire a consultant firm for implementation of measures (SSL, 2014). Authorities contact the resort about other issues. Before a new regulation is adopted the Ministry of Tourism invites resort operators to take part in consultation meetings were they discuss and give comments about it (MT, 2014). If guidelines or regulations regarding the tourist sector is revised MT publish this on there website and if there are major changes the ministry tries to communicate by email to the general manager or responsible staff within the regarding sector.

# 6. Discussion

## 6.1 Results discussion

In this study a comparative case study has been carried out with the aim to map out the adaptive capacity, planned measures, lacking capacity and unused capacity that local people and resorts have on the three islands Maamendhoo, Maavah and Six Senses.

So how do local people reduce their risk to beach erosion on Maamendhoo and Maavah? The result shows that people to some extent have an adaptive capacity to protect themselves from problems regarding beach erosion. Regarding hazard reduction and avoidance the measures that people take could be seen as measures to prevent the beach from getting eroded. For example to put garbage and waste material on the beach that function as temporary sea walls. But most of the people put this on the beach since there is no waste management system on the islands. So when people say that they put these things on the beach the main reason for this is most of the times that they have no other place to put it. People also plant trees and do not take sand from the beach (according to Maldivian law) which also is important for minimize the erosion impacts. To connect to another study about risk reduction the engagement in RR and adaptation tend to be higher in developing countries since governance systems mostly exclude poor people who live in marginal areas (Wamsler, 2014). People in the Maldives are very spread out and people in Laamu atoll are far away from the central government. Even if this is the case, people in general do not have enough capacity to implement risk reduction measures. This is of course related to the fact that people do not have economic capacity to take measures and that people are lacking knowledge about what they can do, and is the main weaknesses in the adaptive work that local people want to take against beach erosion problems. This shows how vulnerable people are to erosion problems and that they are dependent on help from the authorities on Maldives. The reason why people do not take their own initiatives also relates to a common belief among people that the authorities will help them in the future. This is a rather unexpected result since people also express that they do not get the help from the authorities that they are asking for. A lot of people are disappointed on the national authorities, and want to get more help reading beach erosion problems. The reason why people have a strong belief that the authorities will help them and that they do not take measures by themselves can be related to the fact that the Maldivian people have received a lot of help from foreign countries after the tsunami. It can also relate to the decentralization process in the country. The country has had a dictatorial regime for thirty years and Maldives have only been a democracy since 2008. As one respondent on Maavah expressed the situation:

*Before the tsunami the communities had much social bond. The community used to work as a family. People were very friendly and used to help each other. They took responsibility for their issues and their problems. But the democracy came to Maldives not in a very good way. People believe are changed. They believe in their mind that the government need to do everything. People do not believe that they themselves have responsibility, they believe that government shall do everything for them. And the government are promising things that they can not do (Respondent-4, 2014).*

One study about how people adapt to climate change states that past disaster motivate people to take responsibility for risk reduction (Van Aalst, Cannon, & Burton, 2008) but this seems to not be the case in Maldives. According to the Maldivian Red Crescent, disaster risk reduction are not a priority of local people according to a vulnerability and capacity assessment they did on four islands on Maldives (MRC, 2014). Local people expect the government to do something when a disaster happens. The reason why people do not do so much by themselves may also be because the government focuses a lot on top-down measures. This means that it is the government that is responsible of doing the measures, and not local people. This of course makes people not to take their own initiatives, but instead wait for the authorities to do something against the problem.

By looking at preparedness for recovery, people do not have insurance for damages caused by erosion on their properties. In more developed countries people see insurance as the only protection they need when a hazard strikes (Wamsler, 2014). This links to a strong trust in social security systems. Because of this local people in developed countries will not take risk reduction and adaptation actions themselves. Even if local people in the Maldives do not have insurance, they have a strong belief that national authorities will help them if a disaster happens. For example that authorities will repair people's houses if they get damaged.

On Six Senses, Maamendhoo or Maavah planned measures were only found under hazard reduction and avoidance, and on Maamendhoo also under vulnerability reduction. This shows that the main focus for both local islands and resorts is to reduce the risk for erosion. The reason for this may be that they see erosion that is something that is continuously happening and that it is not related to extreme weather events like storms.

Another aim with this study is to analyze how the adaptive capacity differ between local islands and resort islands in Laamu atoll on Maldives. The resort Six Senses are taking many measures to reduce their risk to beach erosion and differ a lot with the measures that Maamendhoo and Maavah take. Six Senses has much more used capacities than the local islands, while the local islands instead have more unused and lacking capacities. The reason for this is that they have more economic capacity to pay for different types of measures, even if they finance all the measures by themselves. This fact has also been mentioned in another study about the perception of coastal adaptation in the Maldives:

*The Maldives is really two blocks of islands, those that act as tourist resorts and are populated almost entirely by tourists and resort staff, and those home to ordinary Maldivians. The first group of rich islands can afford things like harbors and land reclamation, the second group cannot. There is thus a very real income gap between islands, and it affects what communities in the second group can actually do in the face of climate change (Sovacool, 2011).*

Regarding the question whether there are any gaps or weaknesses in the adaptive work that local people take against beach erosion problems, the weaknesses is presented in the matrixes in chapter 5 under unused and lacking capacities. As mentioned before people in general do not have economic capacity to do things, and they need more knowledge about erosion issues. What are the possibilities to build upon the lacking capacities in the future? In the aspect of local people they are very dependent on the authorities since they do not have the economic capacity. Since the authorities do not have the capacity to help every island in Maldives, it is also the responsibility of individuals to take their own measures, in the best way that they can. Regarding the resort Six Senses, they do not show lacking capacities to the same extent as local islands. One measure under preparedness for response was that resort guests and staff do not have any alternative place to stay if the resort will be damaged by erosion. The possibility of staying on other inhabited islands can be a temporary option. But maybe this is not prioritized since the guests have the possibility to fly home if this happens, and the staff building is located on the middle of the island.

Regarding if there are any gaps in the measures that people take can be analyzed by looking if the measures have flexibility, inclusiveness and which thematic focus that is there. The measures that people take are generally cheap and initiated by grandparents. The used capacity of local people was found mostly under the measures hazard reduction and avoidance and preparedness for response on Maamendhoo, but on Maavah all of the measures could be found. This means that the *inclusiveness* of all risk reduction and adaptation measures are lacking on Maamendhoo. Inclusiveness means that all the four potential risk reduction and adaptation measures are used to guarantee that every risk factor is taken into consideration (Wamsler, 2014). The reason why local people do not take measures that are vulnerability reduction and preparedness for recovery can be found under the lacking capacity. People are not able to remove their properties or electric cables, because the government owns the land. They also do not have economic capacity for repairing their houses if it will be damaged by beach erosion. When it comes to *flexibility* which means that it exists more than one measure that can address each risk factor, this exists on both islands regarding hazard reduction and avoidance and preparedness for response. But if you look at Maavah only one measure could be found regarding both vulnerability reduction and preparedness for recovery. This means that if one of the measures by some reason will not function, there are no other measures that could be used instead. Regarding the categorization of the measures taken people only use physical, environmental, and socio cultural ones, but not economic or political/institutional measures. The reason for this can be found when you look at the lacking

capacity. People do not have any economic capacity to construct measures that are strong and sustainable. One great problem related to political/institutional measures is that people need to get permission for building physical measures by doing an EIA, which people do not afford to do.

Six senses adaptive work have both flexibility, inclusiveness and all the different thematic focus are being used (physical, environmental, political/institutional, economic and socio/cultural). This means that they use their full capacity adaptive regarding beach erosion problems.

### **6.1.1 Suggestions of improvements**

The knowledge from the capacity analysis is used to come up with new potential risk reduction measures or to build upon existing ones to reduce risk in an efficient and comprehensive way. The main measures that local people can take to improve their adaptive capacity against beach erosion problems are found under unused capacity in the matrices in chapter 5. In general there is a great interest on both Maamendhoo and Maavah to learn more about reducing risk, especially among younger people. People also have an interest to learn other people on what they can do. People want to have more information about what they can do to build good protection, and want this information from the government. On Maamendhoo two NGO:s are currently operating, but they are not working with RR. According to local people they think that they would be interested to work with reducing risk for beach erosion problems, but that they would need economic support for this. They would also work with this if the government or the island council asked them to do this. Unfortunately no NGO:s are currently functioning on Maavah. But previously Maavah had NGO.s that worked with putting up nets and moving material to refill the beaches. This could be done again.

When looking at the fundamental conditions that people live under, the measures need to be realistic according to their situation. They can not afford to build strong physical measures and this may be a good reason to focus more on "soft measures" that are less expensive. People already take these soft measures, like planting trees and not taking sand from the beaches, but planting trees could be upscaled more. It is also important that people have knowledge about the current regulations about not to build houses close to the beach. On both Maamendhoo and Maavah this is of course a difficulty since both of the islands are very overpopulated and the availability of land is scarce.

Another alternative for people is to move to other islands, which some people on both Maamendhoo and Maavah want to do. The reason for this is not only because of beach erosion, but also to get better health facilities on more developed islands like Foonadhoo in Laamu atoll. This is also something that the national authorities are planning to do (Englund, 2014), but this is not a common opinion among people. Most of the people are not interested to move from the islands and want the authorities to protect the islands instead.

### **6.1.2 Interaction between local people/resorts and authorities**

This section discusses the most important and interesting results regarding the interaction between authorities and local people/resorts. A general conclusion that may be drawn regarding the interaction between authorities and Six Senses is that they are supporting each others work with erosion, they are complementing each others work and the authorities are assisting with the resources the resort is requesting. In general the interaction between authorities and local people has a more complex result. Local people do not think that the authorities are supporting them in their adaptation work while the authorities experience that the locals are supporting them in their work, with some exceptions. The locals think that the authorities have not done enough to prevent erosion problems. By comparing their capacity analyzes the local people are complementing the authorities gaps/weaknesses in their adaptation work to a certain extent. The local people generally do not get the help they are requesting from the authorities.

The authorities have different views of what the local people's responsibility are regarding beach erosion prevention. One official at EPA thinks locals do not have more responsibility than reporting to the authorities if they are exposed to erosion, while Maamendhoo island council thinks locals should follow national regulations and that they also should protect their property and themselves from erosion. This shows that the authorities do not have a joint approach regarding the local's responsibility and in turn makes it hard for local

people to relate to. Since the authorities have different perceptions it hinders the authorities work to make it in line with the locals adaptive work, and it also result in a situation where the different authorities work are not complementing each other. Local people have a responsibility to tell both what they are doing to prevent erosion and what they are requesting from the authorities, but the problem is that their requests are not always answered. One example is when a local person on Maamendhoo wanted to put sandbags on the beach, but when the authorities did not answer this request. Authorities therefore need to have better knowledge about what local people themselves are doing and what they are requesting in order to make the authorities adaptive work more effective. One suggestion how the authorities may improve the situation is to come up with a common responsibility distribution between local people and authorities, and to inform about it during for example awareness campaigns. Local people are requesting for more information of how they can protect themselves and how they can prevent erosion to occur. This can also be included in an awareness campaign to encourage people to take own measures against erosion. Some campaigns have been carried out but it seems like it has not reached locals on Maavah and Maamendhoo. It is important that these measures corresponds to what local people actually can do, since they are lacking financial resources. Therefore they need to focus on “soft measures” like planting trees.

Local people also have different views of what the responsibility is regarding different authorities. Some people say that it is the island council’s responsibility to contact the national authorities, otherwise nothing will happen. Other people say that the island council will not do anything if they are not interested, and that the national authorities have to implement laws and guidelines that the island councils shall follow. Local people are very dependent on the authorities and think that they are not doing enough to prevent erosion. That is why it is important for the authorities to communicate what the authorities’ responsibility is.

Regarding communication between national authorities and Six Senses/local people, the information from the interviews shows that Six Senses have a close relationship with national authorities like MT and EPA. To compare with the local people they have not a close relationship with the national authorities, but have instead a closer relationship with the island councils. Local people do not communicate directly with the authorities, but go through the island councils if they need help. But the island councils do not have a close relationship with the national authorities either since they do not answer their requests. The reason for this can be because the resort has more money to pay for the services that national authorities can give. Another reason can be because the resort sector bring in much money to the public treasury the authorities have a greater interest in supporting them. The tourist sector is one of Maldives highest source of income since it contributes 27 % to the country’s GDP (UNDP, 2013). A suggestion is that national authorities should pay as much attention to local island’s as they give to resort islands.

The decentralization of Maldives in 2011 implicate that regional and local authorities are therefore not used to deal with these questions. Both local people and regional and local authorities have high expectations that the national authorities shall solve the problem. This shows that a top-down approach exists in Maldives and that national authorities need to have better collaboration with both regional and local authorities and give them tools and encourage them how to deal with the erosion problems better. Maavah island council thinks that the collaboration with national authorities needs to be improved.

The capacity analyses that have been done in this study can be more comprehensive if a risk assessment on the different islands is carried out. The risk assessment would give information about how vulnerable the islands are to beach erosion. This would give a better understanding if the measures that the resort, local people and authorities are taking are enough now and in the future.

The EIA regulation is for a good purpose, to protect the environment in development projects. In the context of erosion protection it has come to divide the stakeholders who want to take physical protection measures to prevent further erosion. The winning stakeholders are the ones who can afford to pay for the measures which are in this case Six Senses. The losing stakeholders are the ones that do not have financial resources which in this case are the regional and local authorities, and the local people. Recently the government has revised the regulations to allow stakeholders to take temporary measures along the coast in an acute situation without permission. This is a way for the authorities to meet the division the EIA regulation causes. In this joint study no examples have been found where the changed regulation has been used. In order to even out the differences between the stakeholders local and regional authorities need to improve their economy. Expressed in the interviews the island councils have more urgent problems to handle than erosion and all resources can

not be spent on erosion protection. Therefore one solution may be to focus more on cheap measures like awareness raising, strengthen regulations and protect the coast with vegetation.

The main problem to implement measures on local islands is that all the authorities and also local people express that they are lacking financial resources. By comparing with the tourist sector both MT and Six Senses express that they have adequate financial resources.

## 6.2 Method discussion

The method that is used in this study is based on the theory of Wamsler (2014), by doing capacity analyses of three different islands in Laamu atoll. This has been a good analytical tool to map out the adaptive capacity that people have, but has been revised by also include lacking capacity and planned measures. To include both planned measures and lacking capacity have in the end given a wider approach to the capacity analyses.

It is interesting to see what capacities that people and resorts are lacking and can explain why they can not do certain measures. It is also important to know that even if the lacking capacities are mapped out, there may not be realistic that they are possible to do.

By including planned measures the willingness of people to do something in the future and develop their work is highlighted in the capacity analyses.

Regarding the conversation interviews it is hard to know when the information you get are enough and when you get theoretical fullness. If more interviews had been carried out, there may have come up new information. But the persons that were interviewed could contribute with a lot of information and since many people know each other on the islands, they could say what other people had done to protect themselves from beach erosion as well. To get as much information as possible from every person, people was generally interviewed one at a time. Sometimes two persons were interviewed at the same time. There were speculations on having focus group interviews, but this was in the end not chosen since it was too many questions and the interviews had taken too long time if everyone could say their opinion about the questions.

Regarding validity, when selecting people to interview it would have been better if older people also were represented in the selection. It is possible that older people could have given information about what was done to protect from erosion previous years. But since a limitation was drawn to only interview people that could speak English, this could not been done.

It is also uncertainties when putting certain measures into the matrices, since it is always a chance that the answer is misunderstood. A common misunderstanding, and that can be a lack of reliability, during the interviews was that people generally said yes when they actually meant no. This created a sense of confusion, but since they could say more than yes or no, the actual meaning of what the person wanted to say could be gained anyway.

Something that would have been good to do before the actual interviews would have been to carry out a test interview to investigate if the questions were well formulated and easy to understand. The interview guide was changed to some extent after the interview on Maamendhoo, and is something that could have been hindered if the interview guides was tested before the interviews for the study. The reason why this was not done is because of time-limitations.

## 6.3 Environmental relevance

Since climate is changing people in Maldives will be more exposed to hazards like sea level rise and beach erosion. This means that they need to be prepared for the future and have adaptive capacity to cope with future hazards. According to another study (Van Aalst et al., 2008), people lack experience in dealing with extreme trends and the new risks may actually weaken current capacities to cope with the situation and create a 'capacity gap'. Since people in the Maldives do not do so many measures to protect themselves from

erosion problems, they measures that they do may be undermined by future climate extremes. This may also be the case with the resort Six Senses.

According to the result people are very exposed to beach erosion and buildings that are close to the beach have the possibility to fall into the water in the future. Some people are aware of this and say that this is a risk that may happen.

It is a very difficult situation in Maldives since the islands are very small and that it is one of the most low-lying countries in the world. There is no easy solution, and people say that they may be forced to move in the future. Some people even say that they might be forced to move to another country and that Australia will give land to people in the Maldives. This is of course an extreme solution, but if this will become reality only the future can tell, and depends on how much the sea level will rise.

# 7. Conclusions

The main conclusions that have been found from this study are here presented.

- The local islands on Maamendhoo and Maavah reduce their risk for beach erosion to a certain extent but are mainly temporary and not sustainable. In general people think this is something that the authorities are responsible to do. Although people can build upon the unused capacities that they have.
- Local people have a responsibility to tell both what they are doing to prevent erosion and what they are requesting from the authorities, but the problem is that their requests are not always answered.
- The resort Six Senses are doing many measures and have high adaptive capacity to prevent the resort island from erosion.
- The reason why the resort have higher adaptive capacity than the local islands is mainly because they have higher economic capacity to finance the measures they want to take.
- Local people have both weaknesses and gaps in the risk reduction and adaptation measures that they take, while resort islands do not have any gaps and weaknesses to a certain extent.
- A general conclusion that can be drawn regarding the interaction between authorities and Six Senses is that they are supporting each others work with erosion, they are complementing each others work and the authorities are assisting with the resources the resort is requesting.
- In general the interaction between authorities and local people have a more complex result. Local people do not think the authorities are supporting them in their adaptation work while the authorities experience that the locals are supporting them in their work, with some exceptions.
- The locals think that the authorities have not done enough to prevent from erosion.
- By comparing their capacity analyzes the local people are complementing the authorities gaps/weaknesses in their adaptation work to a certain extent.
- The local people do not in general get the help they are requesting from the authorities.



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# Appendix A - Capacity analyses of authorities

**Table 1. Capacity analysis of Maavah**

	Used capacity	Planned measures	Unused capacity	Lacking capacity
<b>Hazard reduction and avoidance</b>	<p>-MHI constructed land reclamation on Maavah when building a harbor in 1997 (MvIC, 2014).</p> <p>-MvIC follows national regulation; setback of 20 meters from the coastline (MvIC, 2014).</p> <p>-In 2012 and 2013 MvIC requested the government to reclaim affected areas and to build revetments (MvIC, 2014).</p> <p>-Land exploitation is not allowed on Maavah without permission (MvIC, 2014).</p> <p>-MvIC does not take any sand and no corals from reefs (MvIC, 2014).</p> <p>-The government built a sea wall made of sand/cement bags app. 5-10 years ago to protect an area against beach erosion. It is now swept away by the sea (LAC, 2014a).</p> <p>-Tree plantation on Maavah during the government initiative "Million Tree Programme" in 1996 (LAC, 2014a; RRCAP, 2002).</p> <p>-MvIC has asked the atoll council for help to construct revetments (LAC, 2014b).</p>	<p>-MvIC plans to protect a palm forest as an environmental protection area (MvIC, 2014).</p> <p>-MvIC plans to buy coconut palms from locals to prevent them to get cut down (MvIC, 2014).</p> <p>-MvIC plans to arrange an awareness campaign about environmental issues, including how to prevent beach erosion (MvIC, 2014).</p> <p>-Possible land reclamation by MHI if sand gets left after finishing the ongoing harbor project (MvIC, 2014).</p>		<p>-Due to overpopulation there is no area left to build houses (MvIC, 2014).</p>
<b>Vulnerability reduction</b>				
<b>Preparedness for response</b>	<p>-MvIC uses megaphones to inform local people when a heavy storm is approaching (MvIC, 2014).</p>		<p>-MvIC can provide temporary accommodation if needed (MvIC, 2014).</p> <p>-If people get affected under a storm MvIC would assist them to protect their households but this has not been done yet (MvIC, 2014).</p>	<p>-MvIC does not have facilities to take precautions to reduce the impact of beach erosion when a storm emerge (MvIC, 2014).</p>
<b>Preparedness for recovery</b>			<p>-If beach erosion would occur in a storm event MvIC would report it to NDMC (MvIC, 2014).</p> <p>-MvIC would ask the national government for help if the council is not able to support (MvIC, 2014).</p>	<p>-MvIC does not have the financial capacity to repair damages to beach erosion (MvIC, 2014).</p>
<b>Other measures</b>	<p>-MvIC tries unofficially to arise awareness among local people about erosion problems (MvIC, 2014).</p> <p>-A survey including beach erosion was carried out by EPA in 2011 (MvIC, 2014, EPA, 2014).</p> <p>-MEE carried out a survey on whole Maavah for the beach erosion in between 2006-2008 (LAC, 2014a, EPA, 2014).</p> <p>- Maavah is on MEE's priority list for erosion protection support (EPA, 2014).</p>			<p>-Maavah island does not have an operating NGO that could work with beach erosion protection (MvIC, 2014).</p> <p>-MvIC does not have enough financial resources and knowledge to protect the island against beach erosion (MvIC, 2014).</p>

**Table 2. Capacity analysis of Maamendhoo**

	Used capacity	Planned measures	Unused capacity	Lacking capacity
<b>Hazard reduction and avoidance</b>	<p>-MHI constructed land reclamation on Maamendhoo in 2009 (MIC, 2014a).</p> <p>-MaIC follows national setback regulation in their physical planning (MaIC, 2014).</p> <p>-Tree plantation programme by the council in 2012 (MIC, 2014a, LAC, 2014b).</p> <p>-MaIC has forbidden to plant palm trees close to the coast to reduce size of land chunks lost to erosion (MaIC, 2014).</p> <p>-MaIC has included revetments and their cost in the development plan (MaIC, 2014).</p> <p>-MaIC does not take sand from the beach and no corals from reefs (MaIC, 2014).</p> <p>-MaIC has asked the atoll council for help to construct revetments (LAC, 2014b).</p>	<p>-MaIC plans to plant trees to protect the coastline as soon as their economy allows (MaIC, 2014).</p> <p>-Laamu atoll council will write that Maamendhoo needs revetments in the atoll development plan (LAC, 2014a).</p>		<p>-MaIC does not have financial capacity to take physical measures to protect from beach erosion (MaIC, 2014).</p>
<b>Vulnerability reduction</b>				
<b>Preparedness for response</b>	<p>-MaIC uses loudspeakers and mosques to inform locals when a heavy storm is approaching (MaIC, 2014).</p>		<p>-MaIC plans to arrange two training sessions in DRM. Erosion is not included. (MaIC, 2014).</p> <p>-MaIC can provide temporary accommodation if needed (MaIC, 2014).</p>	
<b>Preparedness for recovery</b>			<p>-MaIC plans to arrange two training sections in DRM. Erosion is not included (MaIC, 2014).</p>	<p>-MaIC does not have financial capacity to buy insurance for the council office to protect from natural hazards (MaIC, 2014).</p>
<b>Other measures</b>	<p>- Two erosion surveys have been carried out by MEE and EPA on Maamendhoo in 2008 (MHI 2014a) and 2012. (EPA, 2014b).</p> <p>-MaIC has requested EPA and MEE for help to protect the island from erosion (MaIC, 2014).</p> <p>-EPA carried out an EIA for the harbor project in 2008. Beach erosion aspects were included (MaIC, 2014; MHI, 2014a).</p> <p>-MaIC has applied to EPA to hire one more staff in order to do erosion protection activities (MaIC, 2014).</p> <p>-MaIC has asked the government if the council can build a resort on a nearby island and then rent it to a tourist company to increase funds (MaIC, 2014).</p> <p>- Maamendhoo is on MEEs and EPAs priority list for erosion protection support (EPA, 2014).</p>	<p>-MaIC plans to monitor the development of erosion after protection measures by the government have been taken (MaIC, 2014).</p> <p>-MaIC plans to carry out an awareness campaign including beach erosion (MaIC, 2014).</p> <p>-MaIC plans to start a cooperative society. The income will be used in the council's budget (MaIC, 2014).</p>	<p>-Maamendhoo have three operating NGO:s. None of them work with beach erosion protection (MaIC, 2014).</p>	<p>-MaIC does not have enough financial resources to protect the island against beach erosion (MaIC, 2014).</p> <p>-MaIC does not have enough staff and education to protect the island against beach erosion (MaIC, 2014).</p>

**Table 3. Capacity analysis of Six Senses**

	<b>Used capacity</b>	<b>Planned measures</b>	<b>Unused capacity</b>	<b>Lacking capacity</b>
<b>Hazard reduction and avoidance</b>	<ul style="list-style-type: none"> <li>-EPA has given permission to construct artificial reefs in 2013 (EPA, 2014).</li> <li>-MT has given SSL permission to build a temporary sea wall made of sandbags (MT, 2014).</li> <li>-EPA has given permission to install seven geotubes on SSL (SSL, 2014a).</li> <li>-EPA has hired the consultant firm Seamarc to install three geotubes (SSL, 2014).</li> <li>-EPA has given SSL permission to do beach nourishment (SSL, 2014).</li> </ul>	<ul style="list-style-type: none"> <li>- If the installed geotubes are successful SSL has permission to install four more geotubes (SSL, 2014).</li> </ul>		
<b>Vulnerability reduction</b>				
<b>Preparedness for response</b>	<ul style="list-style-type: none"> <li>- MT is calling and emailing SSL when a storm is approaching (SSL, 2014).</li> <li>- Atoll council is calling SSL when a storm is approaching (SSL, 2014).</li> </ul>			
<b>Preparedness for recovery</b>				
<b>Other measures</b>	<ul style="list-style-type: none"> <li>-EPA receives monitoring reports from SSL and further communicates it to the central government (SSL, 2014).</li> <li>- MEE and MT are giving report and improvements the SSL can do in their protection work regarding erosion (SSL, 2014).</li> </ul>			

# Appendix B - Interview guide to local people

Name:	Profession:
Sex:	Age:
Date:	Island:
Metres living from the coast:	
Telephone/e-mail:	

## Questions to start with

1) Since when do you live in the community?

2) Are beach erosion more common now than 15 years ago on the island? (From your own experience). What do you think is the main reason that is causing the beach erosion?

3) Have you ever experienced risk associated with beach erosion? Yes    No  
 If yes, in which way?  
 If no, do you know any other person on the island that has experienced this? Yes    No

4) How much responsibility do you have as a local citizen to take precautions for erosion?

5) How much responsibility do the atoll/local council have to take precautions for beach erosion, and how much responsibility do you think they should have?



**Measures taken to protect from beach erosion**

6) Have you taken any precautions to protect yourself or your property from beach erosion? (Own efforts, without institutional help or support) Yes    No

If yes, what kind of measures, have you financed it and was it your idea or someone else idea to do the measure?

7) Have you planted any trees on the island to protect the beach from erosion? Yes    No

If yes, was it your idea to plant the trees? Yes    No

If yes, did you finance it? Yes    No

If no, do you plan to do this in the future? Yes    No

8) Have you ever refilled any material (for example sand) that has been removed by the sea? (Beach nourishment) Yes    No

If yes, was it your idea to do this? Yes    No

If no, do you plan to do this in the future? Yes    No

9) Have you ever build any sea wall? (of for example sandbags/building material/stones/barrels/garbage/trees) Yes    No

If yes, was it your idea idea to build the sea wall? Yes    No

If yes, did you finance it? Yes    No

If no, do you plan to do this in the future? Yes    No

10) Have you been part of a community initiative carried out by the local council to implement measures against beach erosion? Yes    No

11) Do people in the neighborhood help each other to reduce the risk of erosion? Yes    No  
If yes, how? (socio/cultural)

12) Have you ever thought of moving from your house due to the risk of erosion? Do you save money for this purpose? (economical)	Yes Yes	No No
13) Are you member of or do you know any local group that control and monitor the development of beach erosion on the island? (socio/cultural)	Yes	No
14) Have you ever removed any of your properties, like buildings, electric cables, pipelines to protect from erosion? (physical) If no, do you plan to do this?	Yes Yes	No No
15) Have you constructed your property so that it can withstand beach erosion? For example by making it stronger? (physical)	Yes	No
16) Has there been any heavy storm (for example strong winds, strong waves) affecting the island that you or someone that you know have experienced? If yes, which year did the storm occurred? If yes, did the storm had any effect on beach erosion?	Yes Yes	No No
17) What precautions did you take, when you realized that this heavy storm was going to hit the island, to protect yourself and your property from erosion? If you haven't experienced a heavy storm, what would you do to protect yourself from a heavy storm that could create erosion?		
18) Do you dispose of any sandbags, bricks, building material to be able to temporarily protect from erosion. (physical)	Yes	No

19) Do you know of any alternative place where you can stay if your house will be damaged by the erosion. (physical)	Yes	No
20) Can you predict that the storm is approaching? For example by the color of clouds. (environmental)	Yes	No
21) Do the community warn each other when a storm approaches? If yes, how?	Yes	No
22) How do the <i>national authorities</i> communicate with you before, during and after a storm? For example through TV, radio, warning systems, magazines, internet? (3d)		
23) How do the <i>atoll/local councils</i> communicate with you before, during and after a storm?		
24) Would you be able to repair the damages on your property caused by the erosion? Do you think that people in general on Maavah would be able to do this?	Yes	No
25) Do you have contact information to a person or company that can assist you to fix the beach erosion (socio/cultural)	Yes	No
26) Do you have insurance that cover any possible damage on your property due to erosion? (economical) If no, would you be interested to buy an insurance?	Yes	No

27) Are you member of a political party or other organisation, where you can seek assistance for help with beach erosion? (political/institutional)	Yes	No
<b>Planned measures</b>		
28) Do you consider to take any precautions in the future, which?		
<b>Lacking capacity</b>		
29) Do you think that you have enough resources and knowledge to protect yourself against beach erosion? If no, what kind of resources and knowledge would you like to have?	Yes	No
<b>Unused capacities</b>		
30) Is there a local organization that could work with risk reduction of beach erosion (but that currently doesn't do this)	Yes	No
31) Is there an interest among people in the community to learn more about to prevent risk, which could be an incentive to have training courses in hazard reduction.	Yes	No
<b>Interaction between local inhabitants and the authorities</b>		
32) Have you ever asked for help to national authorities, the atoll/local council or NGO to protect yourself or your property from beach erosion? If no, do you know someone on the island that has asked for help?	Yes Yes	No No

<p>33) Have you ever received any help from national authorities, the atoll/local council or NGO to protect your property from beach erosion?          If yes, what kind of help and did you get financial support?          If yes, did you ask for the help or was the initiative taken by XX?          If no, do you believe that you will get any help in the future from the island council/atoll council/national authority?</p>	Yes	No
<p>34) Do you experience that the national authorities and atoll/island councils are doing enough to reduce the risk of beach erosion?          If yes, what have they done to prevent beach erosion on Maavah?          If no, what do you want them to improve?</p>	Yes	No
<p>35) According to your experience, do you perceive that the national authorities and atoll/island councils are hindering or supporting the measures you want to take against erosion?</p>		
<p>36) How do, both national authorities and atoll/island councils, inform you about their current work to reduce risk from beach erosion and the measures they are planning to do on the island?          For example through awareness campaigns?</p>		
<p>37) When the harbor was built an Environmental Impact Assessment was made. Did you had any possibility to say your opinion about this?          If no, would you have wanted to do this?</p>	Yes	No
<p>38) What do you think could be risks that you or the community could face in the future due to beach erosion?</p>		
<p>39) How do you see on the future regarding sea level rise? Are the sea level higher today compared when you where a child?</p>		

# Appendix C - Interview guide to Six Senses Laamu

Name:
Telephone:
Date:
Metres the main building of the resort are from the coast:
Island: Olhuveli
GPS-coordinates:

## Questions to start with

1) When did you started to build the resort and when did the resort opened?
2) Are beach erosion more common now than 10 years ago on Olhuveli? (From your own experience)
3) Have you experienced risk associated with beach erosion?
4) What do you think could be risks that the resort could face in the future due to beach erosion?

<b>Hazard reduction and avoidance</b>		
5) Have you taken any precautions to protect the resort from beach erosion? (Own efforts, without institutional help or support)	Yes	No
Have you been part of a community initiative on a local island to implement measures against beach erosion?	Yes	No
If yes, what kind of measures, have you financed it (3b+2b) and was it your idea or someone else idea to do the measure?		
If no, do you plan to take the measures in the future?		
<b>Examples</b>		
5a) Planting trees (environmental)	Yes	No
Beach nourishment	Yes	No
Artificial reefs	Yes	No
5b) Build sea wall (of any material), permanent or temporary? (physical)	Yes	No
Breakwater (near- or foreshore)	Yes	No
Revetments	Yes	No
Land reclamation	Yes	No
Gryones	Yes	No
Buildings on stilts	Yes	No
5d) Have you ever moved the resort due to the risk of erosion? (physical)	Yes	No
Have you ever removed any buildings, roads on the island due to the erosion?	Yes	No
Have you ever removed any electric cables, sewage pipelines? (physical)	Yes	No
If yes, have you saved money for this purpose? (economical)	Yes	No
5e) Do you monitor or control the development of beach erosion on the island? (socio/cultural)	Yes	No
<b>Vulnerability reduction</b>		
5g) Do you construct the resort buildings, infrastructure, so that it can withstand beach erosion? (physical)	Yes	No
5h) When you construct buildings or infrastructure, do you ensure that builders are trained in erosion proof construction? (physical)	Yes	No

5h) Have you removed or moved sewage pipelines or electric cables to higher elevation? (physical)	Yes	No
5i) Are you lobbying with political parties or NGOs to obtain assistance for the work against beach erosion? (political/institutional)	Yes	No
5j) Do you interact/cooperate with people in the local communities in Laamu atoll to implement measures against beach erosion? (socio/cultural)	Yes	No
<b>Storm events</b>		
Have you experienced any heavy storm since you started the construction of the resort?	Yes	No
If yes, did the storm created beach erosion?	Yes	No
6) When a category 3 storm is hitting Maldives, the Maldivian Meteorological Service are giving out warnings. Do you receive these warning from any authority or do you find out this by yourself?		
7) How do both the national authorities and atoll/local councils communicate with you during and after a storm? For example through TV, radio, warning systems, magazines, internet? (3d)		
8) Do the resort warn other islands (councils or local people) in Laamu atoll that a storm is approaching?	Yes	No
<b>Preparedness for response</b>		



8) When you realize that a storm is going to hit the island, what precautions do you take, until the storm emerge, to protect the resort from beach erosion?

**Examples**

6a) Do you dispose of any sandbags, bricks, building material to be able to temporarily protect from erosion. (physical) Yes No

6b) Do you know of any alternative place where you and resort guests can stay if the resort will be damaged by the erosion. (physical) Yes No

6c) Can you predict that the storm is approaching?  
 For example by the color of clouds. (environmental) Yes No  
 If yes, do you then prepare yourself if you realize that a storm is approaching? Yes No

6d) Do the resort warn the guests when a storm approaches? (socio/cultural) Yes No  
 If yes, how:

**Preparedness for recovery**

7) What do you do after the storm?

**Examples:**

7a) Repair the damages from erosion. For example repair:  
 Wastewater pipes (to reduce risk of environmental contamination)(environmental) Yes No  
 Sea walls, revetments (physical) Yes No

7b) Refill the material that has been removed (physical) Yes No

7c) Do you keep yourself updated about which precautions to take after beach erosion has occurred. For example having contact information to a person or company that can assist you to fix the beach erosion (socio/cultural) Yes No

7d) Do you have insurance that cover any possible damage on your property due to erosion? (economical) Yes No

7e) Are you member of a political party or other organisation, where you can seek assistance for reconstructing your property? (political/institutional) Yes No

8) When a storm is causing severe erosion. How much responsibility do you have to make precautions before the storm, during the storm and after the storm?

9) How much responsibility do national authorities and atoll/local councils have and how much responsibility do you think they *should* have? (3a+d)

**Planned measures**

9) Do you consider to take any precautions in the future, which?

**Lacking capacity**

12) What would the resort like to do to protect your properties from beach erosion, but that you currently can not do or do not have the resources to? (2b)

13) Do you think that you have enough resources and knowledge to protect the resort against beach erosion? (2b) Yes No  
If no, what kind of resources and knowledge do you need?

## Unused capacities

14) If you think of the resources that you have to protect yourself from erosion, is there any measure that you can do, but that you by some reason don't do? (2b)

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### Examples

14b) Is there any local organization or NGO that coordinate resort companies interest in the Maldives? If yes, do they work with risk reduction of beach erosion	Yes	No
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14c) Do the resort have an interest to learn more about to prevent risk which could be an incentive to have training courses in hazard reduction?	Yes	No
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### Interaction between the resort and the authorities

5j) Do the resort cooperate with any island council on Laamu atoll? If yes, how do you cooperate with them?	Yes	No
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Do the resort cooperate with the atoll council? If yes, how do you cooperate with them?	Yes	No
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Do the resort cooperate with any national authority. For example Ministry of tourism and Ministry of environment, EPA? If yes, how do you cooperate with them?	Yes	No
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If the resort is doing a project that requires an EIA (Environmental Impact Assessment). Do you follow the recommendations in the EIA regarding beach erosion, if there is any recommendation about this? If yes, can you give any examples?	Yes	No
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15) Have you received any help from someone to protect the resort from beach erosion? Yes    No

If yes, who have you received it from?  
For example NGO, local community, island council, atoll council, national authority?

Did you ask for the help or was the initiative taken by XX?

If yes, what kind of help and did you get financial support?

If no, do you believe that you will get any help in the future from the island council/atoll council/national authority? (3b+c)

21) If yes, if you think of the measures that the island council/atoll council/national authority are doing to protect the beach from erosion, how well do you think that these measures relates to your situation/needs?

If they don't, what would you like them to do differently?

16) Do you experience that the national authorities and atoll/island councils are doing enough to reduce the risk of beach erosion for resort islands? (3a) Yes    No

If no, what do you want them to improve?

17) How do, both national authorities and atoll/island councils, inform you about their current work to reduce risk from beach erosion and the measures they are planning to do? For example through awareness campaigns. (3d)

According to your experience, do you perceive that the authorities are hindering or supporting your adaptive measures against beach erosion?



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