



Detailed Island Risk Assessment in Maldives

Social and Economic Assessment Report (Final Draft V1)

Volume I: Summary

DIRAM team

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1 Introduction

1.1 Purpose and context of this report

The purpose of this report is to present the findings of socio-economic risk assessment undertaken for nine selected ‘safe islands’¹ of Maldives.

This report is part of the United Nations Development Programme (UNDP) funded ‘detailed island risk assessment in Maldives’ project. There are two phases in the project. The first phase developed a consolidated study on the natural hazard, environmental and physical risks and vulnerabilities of the nine inhabited islands. This study is the second phase of the project and covers the socio-economic risk and vulnerability assessments. It builds upon the findings in the previous phase of the project and analyse the specific aspects related to the social and economic environments. The broader project has been commissioned following the report, ‘Disaster Risk Profile of Maldives’, which recommended detailed risk and vulnerability analysis of selected inhabited islands.

This report has been compiled by a team of specialist local consultants with the support of UNDP, Department Planning and National Development and Island Offices of the nine inhabited islands. To ensure integration between the two phases of the project, a team member from the first phase of the assessment has been included the present phase.

1.2 Scope of the study

This study will cover the social and economic vulnerability assessment of the overall project. The study contains 10 islands. They are:

1. S. Feydhoo
2. S. Hithadhoo
3. Sh. Fonadhoo
4. Dh. Kudahuvadhoo
5. Dh. Kulhudufushi
6. L. Gan
7. G.Dh. Thinadhoo
8. K. Thulusdhoo
9. G.A. Viligilli
10. Th. Vilufushi

The study has two components: economic and social assessments. The economic assessment establishes the existing economic characteristics, the business elements and processes at risk, the consequences of a disaster, potential mitigation measures to address the vulnerabilities and a preliminary estimate of the costs and benefits of the mitigation measures. The social assessment establishes the social context in the study islands, various socio-economic groups, particularly

¹ The term ‘safe islands’ has been replaced by ‘resilient communities’ at the time of the study. The change has been made by the new administration on December 2008. The fundamental elements built into the concept remains the same but two new dimensions – social and economic – have been added to the new concept. This study has adopted the term ‘safe island’ since the previous components of this study uses the same terminology. There term is treated as a synonym to ‘resilient communities’.

vulnerable groups, community perceptions about disasters, community organization, disaster impacts on various groups and potential mitigation measures for social risk reduction.

1.3 Assessment methodology

The overall assessment framework follows the model proposed during the first phase of the project. The model specifies the framework to integrate the five main components of the study: natural hazard, environment, physical, economic and social vulnerability assessments. For more details of the framework, refer to the methodology Chapter of this report.

1.3.1 Economic Assessment

The economic assessment method has been modified using the US National Oceanic and Atmospheric Agency (NOAA) model. The components of the modified method are as follows:

- a) Identify the structure and characteristics of the economy: basic and non-basic economic sectors² (using economic base model), locate key economic centres and large employers, map the economic linkages and value the economy.
- b) Identify economic element at risk and their vulnerability
 - a. Identify intersections (or overlap) of economic centres and high-risk hazard zones.
 - b. Conduct a general inventory of high-risk economic centres.
 - c. Identify large employers and their intersection with high-risk hazard zones.
 - d. Conduct a vulnerability analysis on structures of large employers as “critical facilities”.
- c) Estimate the losses from specific natural hazards as defined in the natural hazard component of the study.
- d) Propose and value mitigation measures.

The data for the assessment was collected from a number of published statistical sources and during field visits.

1.3.2 Social Assessment

It was difficult to identify a single cohesive model that could fit the Maldivian context given the smallness of the settlement concerned and the social capital characteristics. The framework presented in this study is inspired by existing models but devised independently to suit the island conditions. It is also specifically designed with simplicity in mind, since the whole idea of this entire project is to create a set of methodologies which could be easily replicated by less technical staff on to other islands.

The methodological framework is divided into 5 main components: a) identifying key population characteristics; b) identifying potential vulnerable groups; c) assessing actual vulnerability of the groups identified; d) assessing composite vulnerability and; e) evaluating risk management options.

² The basic sector comprises of local firms (businesses) that are entirely dependent upon external factors – they export their products and services to other islands and countries. The non-basic Sector, in contrast, comprises of those firms that depend largely upon local business conditions – they mainly serve the local market.

2 Economic Assessment

2.1 The structure and value of the local economies

Table 2.1 below summarises the structure and value of the economies³ in the study islands.

The structure of the economy was poor in most economies – i.e. the level of economic diversification was minimal. Most economies were dominated by fishing industry as their basic sector and civil service and public administration as the non-basic sector. In almost all islands, the employment in public administration sector was 30-40% of the employed population. These patterns are typical of most ‘island economies’ in the Maldives, except in the Male’ urban region. In comparative terms, the most structurally diversified economies are Kulhudhuffushi, Hithadhoo and Kudahuvadho. The least diversified economies are Funadhoo and Viligilli.

Most islands have a similar economic structure. The basic sectors comprise of fishing, manufacturing, wholesale trade, agriculture and tourism. The strongest economies had all these major sectors. Fishing was the dominant sector in all islands except Feydhoo, Thulusdhoo and Mathimaradhoo ward of Gan. Wholesale trade is a key business activity of most large islands studied perhaps because they are largest economies in their respective atolls. The role of agriculture is low in most islands, particularly in islands with high population densities (e.g. Kulhudhuffushi, Thinadhoo and Vilufushi). The direct links to tourism in most of these islands are surprisingly small. Perhaps, this is because only Thulusdhoo have resorts within close proximity. Nonetheless direct links with tourism were found in income remittances from temporary migrants, manufacturing sector and transport sector. The indirect links to tourism are obvious in all sectors.

The size of the economy varied between the nine islands studied. The largest economies were Hithadhoo (Rf1.2 billion) Kulhudhuffushi (Rf1.2 billion), and Thinadhoo (Rf0.65 billion). In terms of the investment infrastructure, Hithadhoo, Kulhudhuffushi, Thinadhoo and Gan had the largest investments. In terms of monthly production, again, Hithadhoo, Kulhudhuffushi and Thinadhoo led the way.

³ An attempt was made to value the economy using replacement costs for the existing infrastructure and monthly average value of production in the sectors. The figures give a crude estimate of the size of the economy but should not be regarded as absolute values.

Table 2.1: Summary of the economic structure and value of study islands

Island	Basic Sectors	Major non-basic sectors	Key Infrastructure	Value of Public Investments (Millions Rf)	Value of Private Investments (Millions Rf)	Value of production (one month) – Millions Rf	Total (Millions Rf)
Kulhudhuffushi	Fishing, wholesale trade, manufacturing (rope making, boat building and food processing), agriculture and tourism	Civil service, construction, transport, personal services , hotels and restaurants, and health care.	Regional hospital, power, regional port , island harbour, sewerage network, secondary school , religious facilities, roads, vocational training centre, waste management site, bank branch, two telecom. sites and public administration facilities.	582	643	52	1,278
Funadhoo	Fishing and fish processing, construction, manufacturing, (Rope making) and tourism.	Civil service, construction , transport, wholesale and retail trade, agriculture, transport, personal services, and hotels and restaurants.	Atoll hospital, power, harbour , school, roads, telecom. sites, religious facilities, public administration facilities and waste management site.	176	152	14	343
Thulusdhoo	Manufacturing (soft drinks, processed food, boat building); Fishing and fish processing, construction and Tourism.	Civil service, construction , retail trade, personal services, hotels and restaurants, and agriculture.	Health centre, power , public jetty, commercial jetty , customs services, schools, roads, telecom. sites, public administration facilities, religious facilities, fuel supply, waste management site, RYVTC, Coca Cola factory and community centre.	124	144	11	279
Kudahuvadhoo	Fishing, agriculture, manufacturing (boat building, and food processing), construction and	Civil service, construction, whole sale and retail trade , personal services (tailoring, salon etc...), hotels and restaurants.	Atoll hospital, power, island harbour , sewerage network, sewage treatment plant, atoll school , boarding house, primary schools, roads, vocational training centre, waste management site, bank branch, religious facilities, two telecom. sites and public	198	134	12	344

Island	Basic Sectors	Major non-basic sectors	Key Infrastructure	Value of Public Investments (Millions Rf)	Value of Private Investments (Millions Rf)	Value of production (one month) – Millions Rf	Total (Millions Rf)
	tourism		administration facilities				
Gan				271	200	18	489
- <i>Thundi & new settlement</i>	Fishing and fish processing, agriculture and transport services (MTCC)	Civil service, construction, local transport services , construction machinery renting, wholesale and retail trade , personal services (tailoring, salon etc...), hotels and restaurants.	Island harbour , secondary School (under construction), power house, link road , school, administrative infrastructure (Island administrative complex – includes bank and all administrative offices), religious facilities, community centre, fuel supply and communications infrastructure.	-	-	-	-
- <i>Mathimaradhoo & Industrial zone</i>	Agriculture , fishing, and wholesale trade.	Civil service, construction, retail trade , mechanical engineering, personal services (tailoring, salon etc...), hotels and restaurants.	Atoll Secondary School, regional hospital, power house , school, administrative infrastructure (Island office and court), religious facilities, community centre, fuel supply and communications infrastructure.	-	-	-	-
- <i>Mukurimagu</i>	Agriculture, fishing and fish processing.	Civil service, construction, retail trade , personal services (tailoring, salon etc...), hotels and restaurants.	School, harbour (under construction), power house , school, waste treatment plant, administrative infrastructure (Island office and court), religious facilities and communications infrastructure.	-	-	-	-
Viligilli	Fishing, manufacturing, wholesale trade (includes fuel), agriculture and tourism	Civil service, construction, retail trade, personal services (tailoring, salon etc...) , sand mining, transport	Atoll hospital, power, island harbour , sewerage network, atoll secondary school , primary schools, roads, oil storage facilities, waste management site, bank branch, religious facilities, two telecom. sites and public administration facilities.	188	168	15	371

Island	Basic Sectors	Major non-basic sectors	Key Infrastructure	Value of Public Investments (Millions Rf)	Value of Private Investments (Millions Rf)	Value of production (one month) – Millions Rf	Total (Millions Rf)
		services, hotels and restaurants.					
Thinadhoo	Fishing and fish processing, wholesale trade, manufacturing (boat building and food processing), agriculture and tourism	Civil service, construction, retail trade, transport services, personal services (tailoring, salon etc...), manufacturing (mineral water, food processing, carpentry, workshops) sand mining, hotels and restaurants.	Regional hospital, power , desalination plant (under construction), island harbour , sewerage network, secondary school , other schools, religious facilities, fish market, cold storage, oil storage, roads, vocational training centre, bank branch, two telecom. sites and public administration facilities	266	337	24	627
Feydhoo	Manufacturing (food processing), construction, transport , hotels and restaurants, fishing.	Civil service, retail trade , transport services, personal services (tailoring, salon etc...), sand mining, hotels and restaurants.	Health centre, power grid, island harbour, Addu Link Road, bridges , sewerage network, schools, religious facilities, roads, two telecom. Sites and public administration facilities	161	187	8	356
Hithadhoo	Fishing and fish processing, wholesale trade, manufacturing (food processing), agriculture and tourism	Civil service, construction, retail trade, transport services, personal services (tailoring, salon etc...), manufacturing (bakery, carpentry, workshops), hotels	Regional hospital, power station and grid, regional port, island harbour , sewerage network, atoll secondary schools, Addu Link Road, bridges , other schools, religious facilities, roads, floodway, waste management site, cable TV network, bank branch, road maintenance unit, police training school, two telecom. sites and public administration facilities.	643	597	35	1,273

Island	Basic Sectors	Major non-basic sectors	Key Infrastructure	Value of Public Investments (Millions Rf)	Value of Private Investments (Millions Rf)	Value of production (one month) – Millions Rf	Total (Millions Rf)
		and restaurants.					
Vilufushi ⁴	Fishing and fish processing	Civil service, construction, retail trade , transport services, personal services (tailoring, salon etc...), manufacturing (bakery, carpentry, workshops)	Health centre, power grid, island harbour, coastal protection, sewerage network, desalination plant , schools, religious facilities, roads, telecom. site and public administration facilities	465	188	4	657

⁴ There were only a limited number of economic establishments on Vilufushi as the survey was undertaken only three months after resettlement. The figures presented here are a snapshot of the economic situation at the time of the survey and may not reflect the true nature economic activities in the near future.

2.2 What is at risk?

The information on the island economy was compared with the findings of the natural hazard assessment component of the project to determine the economic elements and processes at risk on each island. Information on the island economy includes the data on vulnerability and economic values of public infrastructure, key employers, households and business establishments. This data, when overlaid on the hazard zone maps using a GIS, provide an estimate of what economic elements and process are at risk to a given hazard. The table 2.2 below provides a summary of the key elements and economic sectors at risk for each of the islands. The general findings from this assessment is summarised below.

- a) The coral islands of Maldives are particularly vulnerable to coastal flooding events due to their geophysical setup – i.e. low elevation, small size and narrow width. When infrastructure and economic development occurs on the island, they are naturally located within close proximity to the coastline. Approximately 97% of all infrastructure and business establishments from all 9 study islands are located within 500 m of the coastline. In addition, approximately 99% of households were located within 500 m of the coastline. In fact, three out of the nine islands barely had 500 m in their width while remaining islands had an average width less than 1000 m. The tsunami of 2004 showed that such an event could easily reach 500 m inland and in the case of Gan, 1,000 m inland. Thus, it would not be an overestimation to begin this assessment with the assumption that all business elements in islands vulnerable to tsunami are at risk. What needs to be determined is the extent of the exposure. The tsunami perhaps is the most extreme type of coastal flooding hazard predicted for the Maldives. However, the effects of potential swell waves and storm surges are also significant due to their capacity to reach about 200-300 m inland.
- b) Amongst the hazards studied in this assessment tsunami was found to have the most significant number of economic investments, infrastructure and production as risk. It is followed by swell waves or storm surges, which have similar characteristics albeit with a lower intensity. Other major hazards that are likely to severely affect the economic establishments and functioning are rainfall flooding and strong wind. Impacts from hazard such as earthquakes and droughts have not been measured as they were found to be too small in the preliminary assessments. In hindsight, thunderstorms may cause significant temporary damage to economic establishments and should be considered in future studies.
- c) The economic and lifeline infrastructure that was most at risk to coastal flooding events were identified as the harbour, power house, hospital and communications infrastructure.
 - The harbour in six out of the nine islands were identified as vulnerable to a tsunami event due to their location, design and construction method and characteristics of tsunami wave behaviour. Two of the nine islands (Gan and Feydhoo) had resilient designs and construction methods. The harbour is considered one of the most critical lifelines as it is the means to quick evacuation and emergency aid. Moreover, it is the lifeline for the most of the economic activities on the island, particularly fishing, transport and trade.
 - The hospitals in four of the nine islands were identified as vulnerable to flooding events. Moreover, all three regional hospitals (Kulhudhuffushi, Thinadhoo and Hithadhoo), the highest tiers of health service, are located in high risk zones. The

need for hospitals to be located in an accessible location invariably leads to its construction close to the harbour (except for Hithadhoo).

- The power houses in six of the nine islands studied are within 100 m of the coastline. This is mainly due to the accepted practice of locating power houses away from the main settlement. All these establishments are at significant risk during a flooding event. In addition, two of the power houses are located in topographically low areas with the risk of rainfall flooding. A power house is a key lifeline for a number of economic activities. Disruption of power for over 48 hours can damage stock and produce, and halt operations in some sectors.
 - The communications infrastructure of the two telecommunications companies are almost always located close to the coastline, exposing them to risk from flooding events. Damage to any of these facilities may affect not just the island but a number of atolls. Communications infrastructure is a lifeline facility for most economic sectors.
 - Other infrastructure most commonly at risk as sewerage networks, waste management sites and public administration buildings.
- d) The economic establishments and investments most at risk are fishing vessels, agricultural plots, warehouses, retail stores, fuel storage and supply services, fish processing facilities, transport vessels and vehicles, households (building and personal belongings), boat yards, manufacturing services (rope making, carpentry and workshops) and backyard crops. There are significant variations amongst islands in terms of the exposure and are largely related to the size of the economy. Hence, islands such as Kulhudhuffushi, Hithadhoo and Thinadhoo have more establishments at risk compared to Kudahuvadhoo or Funadhoo.
- e) It was observed that at least one of the basic sectors supporting the economy is at risk in every island. Usually these sectors are fishing, agriculture or manufacturing, or a combination. Damage to basic sectors affects the functioning of the economy since they are main export earners for the economy.
- f) The most resilient sectors were identified as public administration and construction. As noted above, 30-40% of the employment in all the nine islands is in the public administration and civil service sector. However, it is unlikely that staff layoffs will be considered by the Government following a disaster. The construction sector should be considered a beneficiary of disasters since the reconstruction that follows will create a significant number of new jobs and increase the production in the sector. In fact, the well developed construction sector in some of these islands is the result of the tsunami of 2004.
- g) A number of sectors and economic establishments outside the local economies have an influence on the functioning and health of the local economy. The most significant is the tourism sector, which dictates a large proportion of the income flow to the economy both through direct and indirect links. All the islands studied received income as remittances from the temporary emigrants and only two have tourism establishments on the island. Indirect income flows include the transport, manufacturing, fishing, construction sector and public administration. Significant income flows come through Government projects and civil service employment, since over 70% of the Government revenue comes from the tourism sector. Hence, tourism sector investments at risk outside the islands will also have a significant impact on the local economy.

- h) There was an observed difference in the exposure of business establishments and key infrastructure between the islands being developed with safe island features and those without them. This observation made in Viligilli Island, where the first component of the study was undertaken without the land reclamation and coastal protection, while the socio-economic assessment was undertaken after reclamation and coastal protection. The addition of new land towards the oceanward side and the construction of a 2.4 m high breakwater have changed the exposure patterns for a number of establishments. Moreover, if the proposed safe island features on Viligilli is modified as suggested in the first component of this study, the remaining establishments at risk may also be reduced significantly.

Table 2.2: Summary of major economic elements and sectors at risk for various hazards

Island	Tsunami	Swell waves or storm surges	Rainfall flooding	Strong wind
Kulhudhuffushi	<p>Infrastructure: Port, island harbour, power house, roads, regional hospital, waste management site, sewerage system, schools, communications facilities, emergency services and public administration buildings.</p> <p>Private investments: Fishing vessels, fuel supply, warehouses, retail shops, cafés, boat yard, households, back yard crops and fish processing.</p> <p>Sectors: Fishing, rope making, boat building, wholesale & retail, tourism, transport, public administration, workshops and agriculture.</p>	<p>Infrastructure: Port, island harbour, power house, regional hospital, roads, waste management site, sewerage system, communications facilities, schools & emergency services.</p> <p>Private investments: fuel supply, warehouses, retail shops, cafés, boat yard, households and fish processing.</p> <p>Sectors: Fishing, rope making, boat building, wholesale & retail, transport, tourism, back yard crops, public administration, workshops and agriculture.</p>	<p>Infrastructure: Power house, road maintenance services, roads, communication facilities and schools.</p> <p>Private investments: Warehouses, retail shops, cafés, households and fish processing.</p> <p>Sectors: Rope making, wholesale & retail, transport and agriculture.</p>	<p>Infrastructure: All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p>Private investments: All land based investments.</p> <p>Sectors: Boat building, wholesale & retail, workshops, transport and agriculture.</p>
Funadhoo	<p>Infrastructure: Island harbour, power house, roads, waste management site, sewerage system, pre-school, communications facility (Wataniya), youth centre, atoll hospital, and public administration buildings.</p> <p>Private investments: Fishing vessels, retail shops, boat yard, households, back yard crops and fish processing.</p> <p>Sectors: Fishing, boat building, rope making, retail, tourism, transport and public administration.</p>	<p>Infrastructure: Island harbour, power house, roads, waste management site, communications facility (Wataniya), youth centre, atoll hospital, and public administration buildings.</p> <p>Private investments: Boat yard, households, backyard crops and fish processing.</p> <p>Sectors: Fishing, boat building, tourism, transport, public administration.</p>	<p>Infrastructure: Power house, roads, waste management site, atoll hospital, and public administration buildings.</p> <p>Private investments: Households, backyard crops and fish processing.</p> <p>Sectors: Transport, fish processing and rope making.</p>	<p>Infrastructure: All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p>Private investments: All land based investments.</p> <p>Sectors: Boat building and back yard crops and trees.</p>
Thulusdhoo	<p>Infrastructure: Island jetty and ‘cola’ (industrial) jetty, power house, health centre, roads, sewerage system, school, emergency services, communications facility (Wataniya & Dhiraagu), customs, fuel storage, RYVTC and public administration buildings.</p>	<p>Infrastructure: Power house, roads, sewerage system, communications facility (Wataniya & Dhiraagu), Island jetty and ‘cola’ (industrial) jetty, and public administration buildings.</p> <p>Private investments: Retail shops, households, back yard crops, fish</p>	<p>Infrastructure: Roads, sewerage system, school, RYVTC and public administration buildings.</p> <p>Private investments: Retail shops, households, back yard crops, Coca Cola factory and warehouses.</p>	<p>Infrastructure: All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p>Private investments: All</p>

Island	Tsunami	Swell waves or storm surges	Rainfall flooding	Strong wind
	<p><u>Private investments:</u> Retail shops (including tourist shops), Coca Cola Factory, households, back yard crops, fish processing centre, warehouses and boat yard.</p> <p><u>Sectors:</u> Manufacturing, fish processing, retail, tourism, transport, boat building and public administration.</p>	<p>processing centre, warehouses and boat yard.</p> <p><u>Sectors:</u> Manufacturing, fish processing, retail, tourism, transport, boat building and public administration.</p>	<p><u>Sectors:</u> Manufacturing, retail, tourism, transport and public administration.</p>	<p>land based investments.</p> <p><u>Sectors:</u> Tourism, transport, back yard crops and trees.</p>
Kudahuvadhoo	<p><u>Infrastructure:</u> Atoll hospital, Power, island harbour, sewerage network, sewage treatment plant, roads, waste management site, bank branch and sports facilities.</p> <p><u>Private investments:</u> Fishing vessels, retail shops, crops, households (newly settled area), back yard crops, fish processing centre, warehouses and boat yard.</p> <p><u>Sectors:</u> Fishing and fish processing, agriculture, wholesale and retail, tourism, transport, boat building and public administration.</p>	<p><u>Infrastructure:</u> Atoll hospital, Power, island harbour, sewage treatment plant, roads, waste management site and bank branch.</p> <p><u>Private investments:</u> Fishing vessels, retail shops, crops, households (newly settled area), back yard crops, fish processing centre and boat yard.</p> <p><u>Sectors:</u> Fishing and fish processing, agriculture, transport, boat building and public administration.</p>	<p><u>Infrastructure:</u> Roads, schools, boarding house and sports facilities.</p> <p><u>Private investments:</u> Crops, households, back yard crops, warehouses and retail shops.</p> <p><u>Sectors:</u> Agriculture, transport, retail and public administration.</p>	<p><u>Infrastructure:</u> All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments:</u> All land based investments.</p> <p><u>Sectors:</u> Crops, transport, back yard crops and trees.</p>
Gan				
- Thundi & new settlement	<p><u>Infrastructure:</u> Island harbour, religious facilities, roads and wastewater treatment plant (under construction).</p> <p><u>Private investments:</u> Fishing vessels, households, agricultural crops, machinery and stock, back yard crops & trees, and transport vessels / vehicles.</p> <p><u>Sectors:</u> Fishing and fish processing, agriculture, wholesale and retail, tourism and transport.</p>	<p><u>Infrastructure:</u> Roads and wastewater treatment plant (under construction).</p> <p><u>Private investments:</u> Agricultural crops, machinery and stock</p> <p><u>Sectors:</u> Agriculture and tourism.</p>	<p><u>Infrastructure:</u> Secondary School (under construction), power house, school, administrative infrastructure (Island administrative complex – includes bank and all administrative offices), religious facilities,</p> <p><u>Private investments:</u> households (particularly the new resettlement zone), agricultural crops, machinery and stock and back yard crops & trees</p>	<p><u>Infrastructure:</u> All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments:</u> All land based investments.</p> <p><u>Sectors:</u> Crops, transport, back yard crops and trees.</p>

Island	Tsunami	Swell waves or storm surges	Rainfall flooding	Strong wind
			<u>Sectors:</u> Agriculture , wholesale and retail, tourism and transport .	
- Mathimaradhoo & Industrial zone	<p><u>Infrastructure:</u> Atoll Secondary School, regional hospital, power house, school, administrative infrastructure (Island office and court), religious facilities, community centre, waste disposal site, fuel supply, roads and communications infrastructure.</p> <p><u>Private investments:</u> Fishing (based on damages in Thundi), Households, agricultural crops, machinery and stock, back yard crops & trees, transport vessels (in Thundi) and vehicles, warehouses, retail shops, workshops, carpentries, personal services.</p> <p><u>Sectors:</u> Fishing and fish processing, agriculture, wholesale and retail, transport, manufacturing (carpentries and engineering workshops), personal services and transport.</p>	<p><u>Infrastructure:</u> Atoll Secondary School, power house, school, administrative infrastructure (Island office and court), religious facilities, waste disposal site, roads and communications infrastructure.</p> <p><u>Private investments:</u> Households, agricultural crops, machinery and stock, back yard crops & trees, transport vehicles, warehouses, retail shops, workshops, carpentries, personal services.</p> <p><u>Sectors:</u> Agriculture, wholesale and retail, transport, manufacturing (carpentries and engineering workshops), personal services and transport.</p>	<p><u>Infrastructure:</u> Atoll Secondary School, administrative infrastructure (Island office and court), religious facilities, community centre and roads.</p> <p><u>Private investments:</u> Households, agricultural crops, machinery and stock, back yard crops & trees and retail shops.</p> <p><u>Sectors:</u> Agriculture, wholesale and retail, transport, and transport.</p>	<p><u>Infrastructure:</u> All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments:</u> All land based investments.</p> <p><u>Sectors:</u> Crops, transport, back yard crops and trees.</p>
- Mukurimagu	<p><u>Infrastructure:</u> All infrastructure. School, harbour (under construction), power house, school, wastewater treatment plant, administrative infrastructure (Island office and court), religious facilities and communications infrastructure.</p> <p><u>Private investments:</u> Fishing, Households, agricultural crops, machinery and stock, back yard crops & trees, transport vessels vehicles, retail shops, workshops, carpentries and personal services.</p> <p><u>Sectors:</u> Fishing and fish processing, agriculture, wholesale and retail,</p>	<p><u>Infrastructure:</u> School, power house, school, wastewater treatment plant and religious facilities</p> <p><u>Private investments:</u> Households, agricultural crops, machinery and stock, back yard crops & trees, transport vehicles, retail shops, workshops, carpentries and personal services.</p> <p><u>Sectors:</u> Agriculture, wholesale and retail, transport, personal services and cafés.</p>	<p><u>Infrastructure:</u> Power house, wastewater treatment plant and roads</p> <p><u>Private investments:</u> Households, agricultural crops, machinery and stock, and back yard crops & trees</p> <p><u>Sectors:</u> Agriculture, retail and transport</p>	<p><u>Infrastructure:</u> All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments:</u> All land based investments.</p> <p><u>Sectors:</u> Crops, transport, back yard crops and trees.</p>

Island	Tsunami	Swell waves or storm surges	Rainfall flooding	Strong wind
	transport, personal services and cafés.			
Viligilli (after reclamation & coastal protection)	<p>Infrastructure: Atoll hospital, island harbour, sewerage network, roads, waste management site, oil storage facilities, two telecom. sites and public administration facilities.</p> <p>Private investments: Fishing vessels, households, back yard crops & trees, warehouses and boat yard.</p> <p>Sectors: Fishing and fish processing, wholesale and retail, tourism, transport, agriculture boat building and public administration.</p>	<p>Infrastructure: Atoll hospital, island harbour, roads, oil storage facilities, two telecom. sites and public administration facilities.</p> <p>Private investments: Households, back yard crops & trees, warehouses and boat yard.</p> <p>Sectors: Wholesale and retail, tourism, transport, agriculture boat building and public administration.</p>	<p>Infrastructure: Atoll hospital, island harbour, roads, Wataniya telecom. site and public administration facilities.</p> <p>Private investments: Households, back yard crops & trees, warehouses, retail shops, workshops, cafés and restaurants and guest house.</p> <p>Sectors: Wholesale and retail, tourism, transport, agriculture and public administration.</p>	<p>Infrastructure: All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p>Private investments: All land based investments.</p> <p>Sectors: Crops, transport, back yard crops and trees.</p>
Thinadhoo	<p>Infrastructure: Regional hospital, power, desalination plant (under construction), island harbour, sewerage network, secondary school, other schools, religious facilities, fish market, cold storage, oil storage, roads, vocational training centre, bank branch, dhiraagu telecom. site and public administration facilities.</p> <p>Private investments: Fishing vessels, households, back yard crops & trees, warehouses, boat yard, ferry terminal, wholesale & retail shops, workshops, pharmacies, cafés, crops, fish processing sites.</p> <p>Sectors: Fishing and fish processing, agriculture, wholesale and retail, tourism, transport, boat building, personal services and public administration.</p>	<p>Infrastructure: Power, desalination plant (under construction), sewerage network, primary school, religious facilities, roads, wataniya telecom. site and public administration facilities.</p> <p>Private investments: Households, back yard crops & trees, warehouses, boat yard, wholesale & retail shops, workshops, pharmacies, cafés, crops, fish processing sites.</p> <p>Sectors: Fishing and fish processing, agriculture, wholesale and retail, transport, boat building, personal services and public administration.</p>	<p>Infrastructure: Power house, island harbour, sewerage network, primary school, roads, sports facilities and public administration facilities.</p> <p>Private investments: Households, back yard crops & trees, warehouses, boat yard, wholesale & retail shops, workshops, pharmacies and cafés.</p> <p>Sectors: Agriculture, wholesale and retail, tourism, transport, boat building, personal services and public administration.</p>	<p>Infrastructure: All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p>Private investments: All land based investments.</p> <p>Sectors: Crops, transport, back yard crops and trees.</p>
Feydhoo	<p>Infrastructure: Health centre, power, Addu Link Road, island harbour, sewerage network, schools, religious facilities,</p>	<p>Infrastructure: Sewerage network, religious facilities, roads, waste management site, Wataniya telecom.</p>	<p>Infrastructure: Island harbour, sewerage network, schools, religious facilities, roads,</p>	<p>Infrastructure: All infrastructure except port and island</p>

Island	Tsunami	Swell waves or storm surges	Rainfall flooding	Strong wind
	<p>roads, Wataniya telecom. Site, sports facilities, and public administration facilities.</p> <p><u>Private investments</u>: Fishing vessels, households, back yard crops & trees, warehouses, retail shops, cafés, fuel supply and souvenir shops.</p> <p><u>Sectors</u>: Fishing, wholesale and retail, tourism, transport, back yard agriculture and public administration.</p>	<p>Site and sports facilities,</p> <p><u>Private investments</u>: households, back yard crops & trees, warehouses, retail shops and cafés</p> <p><u>Sectors</u>: Wholesale and retail, tourism, transport and back yard agriculture</p>	<p>facilities, and public administration facilities.</p> <p><u>Private investments</u>: households, back yard crops & trees, warehouses, retail shops, cafés, fuel supply and souvenir shops.</p> <p><u>Sectors</u>: Wholesale and retail, tourism, transport, back yard agriculture and public administration.</p>	<p>harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments</u>: All land based investments.</p> <p><u>Sectors</u>: Crops, transport, back yard crops and trees.</p>
Hithadhoo	<p><u>Infrastructure</u>: Power, regional port, island harbour, Addu Link Road, sewerage network, atoll secondary schools, other schools, media centre, religious facilities, roads, floodway, waste management site, cable TV network, bank branch, fish market, police training school, two telecom. Sites, road maintenance unit, and public administration facilities</p> <p><u>Private investments</u>: Fishing vessels, fuel supply & storage, transport vessels, warehouses, whole sale & retail shops, workshops, cafés, boat yard, households, back yard crops and fish processing centres.</p> <p><u>Sectors</u>: Fishing and fish processing, boat building, wholesale & retail, tourism, transport, public administration, workshops and agriculture.</p>	<p><u>Infrastructure</u>: Regional hospital, regional port, island harbour, roads, waste management site, road maintenance unit and fish market.</p> <p><u>Private investments</u>: Warehouses, whole sale & retail shops, workshops, boat yards, households and back yard crops</p> <p><u>Sectors</u>: Boat building, wholesale & retail, tourism, transport and agriculture.</p>	<p><u>Infrastructure</u>: Sewerage network, religious facilities, roads, floodway, cable TV network, fish market, police training school, two telecom. Sites, and public administration facilities</p> <p><u>Private investments</u>: Warehouses, whole sale & retail shops, workshops, cafés, personal services, boat yard, households, crops and back yard crops.</p> <p><u>Sectors</u>: Wholesale & retail, tourism, transport, public administration, workshops and agriculture.</p>	<p><u>Infrastructure</u>: All infrastructure except port and island harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments</u>: All land based investments.</p> <p><u>Sectors</u>: Crops, transport, back yard crops and trees.</p>
Vilufushi	<p><u>Infrastructure</u>: Health centre, power, roads, island harbour, sewerage network, desalination plant, schools, religious facilities, Wataniya telecom. site, sports facilities, waste management site and public administration facilities.</p>	<p><u>Infrastructure</u>: Health centre, roads and public administration facilities.</p> <p><u>Private investments</u>: Fishing vessels, households, fuel supply and fish processing centres.</p> <p><u>Sectors</u>: Fishing and fish processing, and</p>	<p><u>Infrastructure</u>: Health centre, roads, sewerage network, schools, religious facilities, and public administration facilities.</p> <p><u>Private investments</u>: households, retail shops, workshops</p>	<p><u>Infrastructure</u>: All infrastructure except island harbour. Mostly secondary risks from falling trees.</p> <p><u>Private investments</u>: All</p>

Island	Tsunami	Swell waves or storm surges	Rainfall flooding	Strong wind
	<u>Private investments:</u> Fishing vessels, households , retail shops, workshops, fuel supply and fish processing centres. <u>Sectors:</u> Fishing and fish processing , wholesale and retail and transport	transport.	<u>Sectors:</u> Wholesale and retail, transport and public administration.	land based investments. <u>Sectors:</u> Transport

Bold: represents infrastructure and sectors most at risk

2.3 Economic consequences of hazard events

Economic losses for specific hazards was analysed for all the study islands. The results provide a comprehensive look at the potential losses based on the hazard maps, hazard scenarios and elements and processes at risk. The findings are estimates based on past experiences in Maldives and other countries, field assessments and published reports. Disaster impact estimation is an inexact science since it involves a wide range of assumptions both about the natural hazard and about the vulnerability of a given element or process. Comprehensive assessments of the consequences of given hazards have been provided in the relevant Island Reports. This section summarises these findings and are presented in the three subsections below.

2.3.1 Summary of the main economic impacts by major sectors

Infrastructure

The most significant damage in terms of the financial value will be on infrastructure. The total estimated value of infrastructure or capital stock (using replacement value method) in the 9 islands is over Rf 3 billion. The most commonly damaged infrastructure are power houses, island harbour, hospitals, schools, sewerage network, waste management, public administration buildings, fish markets and communication infrastructure. Almost all these infrastructure are critical from an economic perspective but the most critical of these are power houses, island harbour, hospitals and communications systems.

The consequences of infrastructure losses on the economy are significant and have knock-on effects with cumulative indirect losses. For example, in Kulhudhuffushi, Kudahuvadhoo and Thinadhoo, the power house is likely to be damaged during a tsunami or swell wave event. It is possible that power will be affected for more than 48 hours, affecting a range of business activities from pharmacies, fish processing and manufacturing. Similarly, the potential damage to harbour in Kulhudhuffushi, Funadhoo, Kudahuvadhoo, Viligilli and Thinadhoo – all fishing islands – are likely to be significant on their fisheries and transport sector. Impacts on transport sector affect all export and trade activities on the island such as agricultural production and wholesale trade. Moreover, damage to the harbour may also mean damage to vessels protected by it. Hence, the key infrastructures are essential business elements for the functioning of a local island economy.

Fishing and fish processing

Among the 9 study islands, all islands except Thulusdhoo and Feydhoo have fishing as the dominant productive sector. The most significant impacts on this sector are likely to occur from a tsunami. Impacts on the fishing vessels are considered the most serious with potential investment losses between 3-5 million for each vessel. In most islands, a small vessel employs 12-16 fishers and a large vessel employs 20-28 fishers. Therefore the livelihood a number of households are lost with the damage to a single vessel. Damages to harbours, fuel supply and cold storage will also affect the operations of the vessels and fishing activity. Moreover, damage to households may force fishers to stay behind for repair work, affecting production in the sector.

A decline in the fishing sector will have knock-on effects on a significant number of non-basic sectors. All major fishing economies rely on the income generated through fishing to boost the non-

basic sectors such as personal services, construction and manufacturing (local demand). This is because fishers often have a larger disposable income compared to those with fixed salaries. Decline in fishery in less diversified local economies are often associated slowing down of the local economy. Conversely a boom in fishing industry is associated with a boom in economic activities such as construction, retail trade and manufacturing.

Fish processing is also a key sector which may be damaged or affected by a flood event. The investments are often low-tech but the stocks are of high value. Damage to production stocks may affect the liquidity in these businesses and reduce their capacity to purchase fish. Moreover, the repair period may see a decline in demand for fish, affecting the fish catch.

Agriculture

Agriculture is practised at a large scale in Gan and Kudahuvadhoo, both with extensive areas of agricultural land. Agriculture plays a minor role in the economies of Kulhudhuffuhi, Funadhoo and Hithadhoo. The investments in agriculture are generally small but the value of the produced crop and stock are significant at an island level. Agriculture is one of the most seriously affected industries during flooding events. Salinization of ground water is often associated with the complete loss of crops and a halt to farming until the next rainy season.

Impacts on other non-basic sectors and infrastructure may have indirect effects on agriculture. Damage to harbour or transport vessels will affect the transport harvest to the markets. If the harvest has to be retained over a longer period, they may be unusable.

Impacts on back yard crops in islands such as Viligilli, Feydhoo, Hithadhoo, Gan and Kulhudhuffushi are significant if flood waters reach the households. The overall secondary effects of losses in farm production and back yard crops is to increase the demand on food, potentially leading to food shortages.

Manufacturing

Local manufacturing activities such as, rope making (Kulhudhuffuhi and Funadhoo), boat building (all islands), food processing (most islands) and furniture making, generate substantial income in most islands. It is usually a source of employment for women. A natural hazard event involving flooding is likely to affect most of the above sector. Often there are direct losses in boat building and furniture making when business establishments are damaged. There are indirect losses in rope making and food processing, when source of raw material is damaged.

Manufacturing is considered a basic sector and a decline in production in the sector is likely to cause a decline in disposal income spent on non-basic sectors. Sectors such as retail, tailoring and other personal services will be affected.

Construction

The construction sector is well-established in all the islands studied. There is likely to be losses to the sector when business establishments and machinery are damaged. However, it is a known fact that construction sector usually enjoys a boom following a disaster. The reconstruction work required following a disaster provides opportunities for more businesses and employment. Often short-term

employment is generated in this sector to accommodate temporary unemployment in sectors such as fisheries and agriculture. However, this sector depends on the injection of Government stimulus to the economy.

Public administration and civil service

The public administration sector, including education, health and social service sectors have the highest employment in all islands. The Government is the single largest employer in all islands. This sector is likely to be affected in terms of infrastructure damage and material losses. However, this sector is one of the safest in terms of employment since the government is unlikely to lay-off staff following a disaster, at least in the short-term. The disposable income from this sector contributes to sustain some of the non-basic sectors such as retail and personal services immediately after a disaster.

Housing

Housing is considered as an economic element in this study. A household if damaged will need to be replaced at a cost to the owner. Households are also one of the smallest units of a society and all economic activities are invariably linked to it. Damage to households have been predicted from all islands, especially during a tsunami. Other damages to content are likely from swell wave events and rainfall flooding events.

Transport

The transport sector is also well-established in all the study islands. This sector generally comprise of passenger and cargo services, both on land and sea. All islands, except, Thulusdhoo have cargo boats which are mainly involved in transporting wholesale and retail goods, vehicles, construction material, furniture and other personal goods from Male'. They are also used to transport agricultural produce to Male'. Land based vehicles are usually taxis for passenger transport and 'pick-up' or lorry for goods transport. Impacts on the sector will be high if harbour, port and road infrastructure are damaged. Similarly, depending on the number of vehicles and vessels damaged, the impacts on the transport industry could be substantial.

Damages to the transport sector will have knock-on effects on numerous basic and non-basic sectors. Impacts of the damages will be felt on key sectors such as agriculture, fuel supply, manufacturing and, wholesale and retail trade.

Whole sale and retail trade

Wholesale and retail trade is a major business activity in all the study islands. Wholesale trade was particularly established in Kulhudhuffushi, Thinadhoo, Viligilli and Hithadhoo. Their business activities involve wholesaling to other islands within and outside the atoll. Retail businesses are also the most common small business in all the 9 islands.

Direct losses to the sector mainly occur when warehouses and retail shops are flooded. Losses under such circumstances may be significant as the stock is usually not insured. This could cause liquidity problems among the affected businesses and increase the recovery period required. Indirect losses may be incurred when the cargo vessels and harbour are damaged.

2.3.2 Other general findings

- a) Economic consequences of a disaster in all islands were found to be highest following a severe tsunami, swell wave event or a storm surge. Effects of other disasters such as rainfall flooding and wind damage are expected to be comparatively low.
- b) A significant proportion of key lifeline infrastructures on most islands are spatially concentrated in high risk zones to coastal flooding from a tsunami, swell wave or storm surge. They include the hospital, power house, harbour and emergency services (police and fire).
- c) The major business establishments and productive assets on most islands are spatially concentrated in the harbour area and along the two or three main roads. Quite often, harbour area is identified as a high risk zone. The harbour area contains the bulk of the fishing industry assets, fuel supply, wholesale assets and the transport industry assets. This spatial setup, coupled with inadequate mitigation measures in the harbour area, exposes most islands to significant economic shocks from severe flooding events.
- d) The economic base of all study islands is narrow and is based on fishing, manufacturing, trade, tourism or agriculture. The larger economies such as Hithadhoo, Kulhudhuffushi and Thinadhoo have a wider combination of these five sectors. The key industries are dependent on external demand from international fish markets, retailers from neighbouring islands, demand for agricultural and manufacturing products from Male', visitors from nearby islands and, the demand (employment, fishing, retail and manufacturing) from tourism sector. They are highly vulnerable to exogenous economic shocks and disaster events in other islands of Maldives. This economic setup also makes them highly vulnerable to economic shocks if the spatially concentrated productive assets of fisheries, transport and trade are damaged.
- e) Manufacturing industry, particularly boat building and rope making may suffer. Damaged vessels under production will suffer liquidity issues if uninsured. The raw material required for making rope may be in short supply immediately after a disaster. Self employed boat builders may suffer when their means of production is lost and may not have the requisite capital to resume work in a timely manner. Damage to household may also prevent women from engaging in manufacturing activities within the household.
- f) There is likely to be a general decline in the economy following a disaster. The affects on the basic sectors may reduce the overall income. The loss of infrastructure and productive assets and development opportunities foregone will affect the economic growth. Expenditure on repair and rebuilding work will reduce the disposable income, affecting the service sector (except construction) and retail businesses. There will be short term unemployment and shift in workers between sectors primarily to construction.
- g) Insurance of large investments was not considered a priority in the study islands. When disaster strikes, damage to high value investments often lead to irrecoverable losses to businesses and individuals. High value investments include transport vessels and vehicles, fishing vessels, vessels under construction, warehouses, fuel storage, carpentries and workshops.

- h) The habit of storing cash and valuables in households and businesses, instead of banks, has led to significant personal losses during the tsunami of 2004. The practice is still dominant in most households, particularly fishermen. When disaster strikes, these households not only lose their property but also their savings.
- i) Development in all study islands is progressing at a rapid rate but disaster mitigation has been given little consideration. More development leads to greater risks and vulnerability to the island economy.
- j) With the current level of investment and, the business infrastructure and establishments at risk, almost all these islands will require assistance from the Government or International Agencies to recover from a disaster.

2.3.3 Costs of disaster

The costs for the economic consequences have been calculated for all islands using the estimates on replacements costs and the extent of damage for major natural hazards. A summary of the financial losses is presented in table 2.3 below. These figures should be taken as guide rather than absolute figures, since the calculation involves average values, a number of assumptions and estimation of physical losses.

As expected, the highest losses are associated with a tsunami followed by swell wave or storm surge related flooding. Losses are comparatively small in the large economies of Thinadhoo and Hithadhoo due to their limited exposure to tsunamis. The cost of rainfall flooding is highest in Kulhudhuffushi, Viligilli, Thinadhoo and Hithadhoo due to the expansion of settlement into poorly reclaimed wetland and reef areas. The biggest losses are in infrastructure and housing stock.

Table 2.3: Summary of tangible losses from natural hazards in the study islands

Island	Tsunami	Swell wave or Storm surge	Rainfall flooding
Kulhudhuffushi	91,107,500.00	28,969,000.00	1,890,500.00
Funadhoo	19,870,000.00	4,328,000.00	670,00.00
Thulusdhoo	17,212,500.00	6,398,000.00	190,000.00
Kudahuvadhoo	17,103,000.00	4,794,000.00	70,000.00
Gan	80,148,000.00	25,515,500.00	413,000.00
Viligilli (before reclamation & coastal protection)	33,803,000.00	4,328,000.00	210,000.00
Thinadhoo	19,567,000.00	2,272,500.00	910,000.00
Feydhoo	45,030,500.00	4,625,500.00	903,000.00
Hithadhoo	83,094,000.00	1,994,500.00	2,686,000.00
Vilufushi	20,228,500.00	2,206,000.00	NA

2.4 Mitigation options

Mitigation measures can reduce the future risk to the economic establishments and processes. Mitigation options have been proposed for the ten study islands based on the risk and vulnerabilities discussed above. A summary of these options is presented in Figure 2.4 below.

Figure 2.4: Summary of mitigation option proposed for the study islands

Mitigation options	Kulhudhuffushi	Funadhoo	Thulusdhoo	Kudahuvadhoo	Gan	Viligilli	Thinadhoo	Feydhoo	Hithadhoo	Vilufushi
Diversifying and strengthening the economic base	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adopting the safe island mitigation measures										
- Coastal protection			✓	✓	✓	✓	✓	✓		✓
- Environment protection zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
- Resilient harbour	✓	✓	✓	✓		✓	✓		✓	
- Evacuation facilities		✓	✓			✓	✓	✓		✓
Flood proofing the hospital	✓			✓		✓	✓		✓	
Flood proofing regional port facilities	✓								✓	
Flood proofing warehouses and stock	✓		✓	✓	✓	✓	✓	✓	✓	✓
Protecting the fuel storage and supply	✓		✓	✓		✓	✓		✓	✓
Flood proofing the power house	✓	✓		✓	✓		✓		✓	✓
Retrofitting to reduce flood risks in high risk houses and buildings	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Flood proofing communications infrastructure	✓	✓	✓		✓	✓	✓	✓		
Earthquake resilient public buildings								✓	✓	
Constructing artificial drainage systems in low lying areas and main roads	✓				✓	✓	✓		✓	✓
Flood proofing waste management sites	✓	✓	✓	✓	✓	✓	✓	✓		
Creating disaster risk awareness among businesses	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adjusting the existing land use plan to relocate key business establishments away from high risk zones.	✓			✓	✓		✓		✓	
Reviewing the new land use plans to relocate key business establishments away from high risk zones	✓		✓		✓		✓			✓
Creating insurance awareness among high risk investments	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Create awareness among the population to use banking facilities to store cash	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mitigating the economic down turn following a disaster										
- Income support to severely affected population	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

- <i>Financing the replacement of key assets and tools of most affected businesses</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
- <i>Marketing campaigns to restore consumer and investor confidence</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Full integration of natural hazard risk assessment in Environment Impact Assessment (EIA) of development projects and mandatory inclusion of mitigation measures.										
Addressing external factors – addressing mitigation requirements for national infrastructure and key industries										
Changing the building code to address housing vulnerabilities in high risk zones										

Mitigation measures proposed here can be classified into four main groups: a) capital investment protection; b) business process preservation; c) risk transfer and; d) legal and institutional strengthening. Protection of the capital stock or investments on the island should be a priority since the resilience of an island economy to a natural disaster is initially depended upon the physical damage. Hence, a number of flood mitigation measures for lifeline infrastructure have been proposed. In addition, the general adoption of the safe island model has been proposed since it contains the combination of mitigation measures which could reduce the most common risks. However, caution is recommended in adopting the safe island plan as a generic set of mitigation measures. The component of the model needs to be modified to suit the specific vulnerabilities of the islands.

The preservation of business processes is also crucial to reduce the economic risks. Business processes are referred here as the economic linkages on the island. One of the key economic vulnerabilities is the narrow economic base of all study islands. Perhaps, this is an inherent feature in small island economies. Nonetheless, efforts need to be placed to diversify the economy so that failure in one activity does not halt the entire economic system. The larger economies studied here have a comparatively wider economic base than the smaller economies. However, these economies would also benefit from more direct involvement in economic activities like tourism. Other measures to preserve the business processes include the potential mitigation measures to minimise the impacts following a disaster. This could also be regarded as part of the preparedness planning for disasters.

Risk transfer is a crucial element missing in the local economies studied. Quite often, the economies rely on the Government to 'bail-out' the local economy following a disaster. However, risk transfer through a combination of community, Government and Insurance agencies could be a better way forward in future risk reduction. Currently, only a few sectors have insured investments. Insurance could be used to transfer the risks to Insurance companies especially amongst the sectors that have significant investments in high risk areas.

Finally, legal and institutional strengthening is required in introducing risk evaluation and mitigation measures into land use planning, building codes and EIA process.

2.5 Viability of the mitigation options

Individuals, household, businesses and policy makers alike have to weigh up whether an investment in a mitigation measure today will be rewarded in the long-run by avoiding a disaster loss sometime in the future. Decisions are relatively straight-forward where the costs of mitigation measures are low and there is a strong likelihood of large financial and human losses in the future. For the rest of the scenarios, decision making is complicated.

This study has valued the costs and benefits of the proposed mitigations measures for each island. A summary of these costs and benefits are summarised in table 2.5 below.

Table 2.5: Summary costs and benefits of the proposed mitigation measures - single disaster event

Island	Mitigation Cost (Rf Million)	Benefits (Rf Million) ⁵	Net benefit (Rf Million)
Kulhudhuffushi	182	91	-71
Funadhoo	156	73	-83
Thulusdhoo	116	47	-69
Kudahuvadhoo	163	55	-103
Gan	354	197	-157
Viligilli (after reclamation & coastal protection)	166	90	-76
Thinadhoo	215	106	-109
Feydhoo	172	131	-41
Hithadhoo	357	260	-97
Vilufushi	58	70	12

- Values being reviewed

The costs for mitigation measures are direct expenditure estimated for implementing the proposed measures. The benefits comprise of two parts: a) the direct and indirect losses avoided from a single severe disaster event and; b) the value of life and injuries avoided. A key determining factor for the viability is the consideration of coastal protection only when necessary. Coastal protection around a large island such as Kulhudhuffushi and Hithadhoo may be desirable but not necessary as there are natural ridges existing on the island. If coastal protection cost is included as proposed in safe island model, the costs, for example in Kulhudhuffushi, exceed the benefits.

In summary, the net benefits are negative when only a single disaster is considered over the next 20 years. This is because the costs of the initial mitigation measures are very high, particularly for coastal protection, harbour construction and property retrofitting. However, the value of losses from a single event is lower than these initial costs. Only Vilufushi Island has a positive net benefit and this is mainly because the costs for a number of existing mitigation measures have not been taken into account in this calculation; only additional requirements have been calculated.

A weakness of cost-benefit analysis in risk assessment is the overwhelmingly large benefits when longer timeframes are considered. The figures presented here are for a single severe event over a 20 year period. However, if a 50 year time period is included, the number of probable severe events increases and with it the potential benefits. Hence, under such circumstances, benefits increase making the assessment less meaningful for planners.

⁵ Cost for a single event.

An alternative calculation, taking into account multiple disasters, is presented in table 2.5 below. The results, however, show that while the net benefits have increased comparatively, the total net benefits are still negative. Three islands – S. Feydhoo, S. Hithadhoo and Vilufushi – have positive benefits.

Table 2.5: Summary costs and benefits of the proposed mitigation measures - multiple disaster events

Island	Mitigation Cost (Rf Million)	Benefits (Rf Million)⁶	Net benefit (Rf Million)
Kulhudhuffushi	183	149	-33
Funadhoo	156	109	-47
Thulusdhoo	116	56	-60
Kudahuvadhoo	163	95	-67
Gan	354	248	-73
Viligilli (after reclamation & coastal protection)	166	124	-43
Thinadhoo	215	169	-46
Feydhoo	172	178	6
Hithadhoo	357	389	32
Vilufushi	58	99	42

The costs should not be considered as one-off investments in mitigation measures. Instead, it should be treated in a broader timeframe and should be incorporated in the public and private development plans of the island. Given the limited resources of Maldives, this is perhaps the only meaningful manner in which the investments on mitigation measures could be made.

⁶ Cost for a single event.

3 Social Assessment

3.1 Vulnerable groups

The following characteristics were observed

- Very few single elderly person households
- Very few households with disabled persons
- Generally expatriates do not live with Maldivians
- Migrants in Funadhoo, Thulusdhoo, Kudahuvadhoo
- Income levels highest in Vilingili and Thinadhoo – Fisheries is dominant

3.1.1 Young Population

The average proportion of young population in safe islands under the age of 15 is 35.5 percent. Among the safe islands the percentage of young population is highest in Villingilli (39%) and lowest in Kudahuvadhoo (31%). On average every other household has a young person below fifteen years of age.

On average, 43.5% of households had children below 5 years of age. The percentage of households with children under five years of age is highest in Funadhoo (58% of households) and lowest in Feydhoo (36% of households).

On average 3.7% of households had more than three under five years children. The percentage of households with more than 3 under five years children is highest in Funadhoo (7%) and lowest in Feydhoo (1%). In absolute numbers, there were 79 households in Hithadhoo with more than 3 under five years children compared to 7 households in Feydhoo.

Figures for children under nine shows a high percentage of households (65.7 percent) having children under nine years. About 70 percent of households in Kulhudhufushi have children below nine years compared to a low of 54 percent in Feydhoo. Children will often find it difficult to evacuate or care for themselves at a time of disaster and the households which has higher number of children may be at risk.

3.1.2 Elderly Population

The proportion of elderly population over the age of 65 is 5.4 percent. Hithadhoo has 568 persons (6%) over the age of 65 years while Thulusdhoo has 57 persons above 65 years of age.

On average 30 percent of households have an elderly person. In Hithadhoo 510 households (34%) have elderly persons. Similar to the children the elderly are often dependent on others to evacuate at a time of disaster and the households which has higher number of elderly may be at risk.

3.1.3 Disabled Persons

It was difficult to determine the true number of disabled population in the islands due to lack of data and limitations in Census data. The only data available suggests that on average 2.5 percent of households have disabled persons over the age of 15.

3.1.4 Female headed Households

There is not enough data to determine the number of households which could explicitly be stated as female headed households. The only available indicator is from the Census 2006 which reports the households without a male working age person. According to these data on average 25.3 percent of households do not have a working age male. In Hithadhoo there are 482 (32 percent) households without a working age male at the time of the census. On the other hand, in Thulusdhoo there are only 22 (12%) households without a working age male.

3.1.5 Households with Single Persons and Only Dependent Persons

Census 2006 reports that there are 60 households with single persons in Thinadhoo and 58 households with single persons in Hithadhoo. There are also 89 households in Hithadhoo with only dependent persons (children under 18 and elderly over 65 years old).

3.1.6 Visitors and Temporary Residents

There is no official record of foreigners in islands. The island office reports on number of foreigners were found to be misleading as well. Field surveys revealed that the figures could be much higher due to a number of unregistered foreigners. No distribution patterns could be established on the island. Most foreigners could only understand limited Dhivehi. Most of those employed in the schools and hospital can speak and understand English. Most foreigners are temporary workers on the island employed by the Government and private sector. From a vulnerability to hazards perspective, it was noted that most foreigners were living in their own housing quarters which increases their vulnerability as there will be language barriers.

The Census data also shows that on average 10 percent of households have temporary local migrants who have come in search of work and for schooling. The proportion of households with temporary local migrants is highest in Funadhoo (23%).

3.2 Coping Capacity

Different forms of social structure and social relations develop to deal with different risks, hazards and situations in community settings. In order to assess the coping capacity of the ten islands, a social capital survey was undertaken. The aim of the survey was to measure various manifestations of social capital as well as its suspected correlates to coping with natural disasters. The methods used for the survey are described in the report.

Networks, rules, norms, values, attitudes and beliefs are different among people who have different patterns of life. Hence, measures of social capital that are relevant for one set of cultures can be irrelevant for others.

The formal organisations may not provide any reliable indication of voluntarism and cooperation among community members and there may be several informal networks that exist in an island and many may attend these networks regularly. Not all forms of social structures and social relations are valid for investigating cooperation and coordination within any particular context. Social capital exists in the relations among persons and only those activities should be considered for measuring social capital that members of a particular culture regard appropriate to carry out collectively rather than individually.

The questionnaire used to measure social capital was adapted from the World Bank developed Social Capital Assessment Tool (Krishna and Shrader 1999) and the World Values Survey. Altogether 25 different aspects of social capital were measured on five different dimensions.

3.2.1 Organizations and Networks

A network is an interconnected group of people who usually share an attribute in common. They can be limited or extensive in size and capacity, and may involve relations within the household, extended family, at the neighbourhood or local community scale, to global and virtual relations that operate at a vast distance. An individual can belong to more than one network at once and the size and capacity of social networks may affect overall stocks of social capital. In order to possess social capital, a person must be related to others, and it is those others, not himself, who are the actual sources of his or her advantage. Hence, individuals and families with large numbers of social ties may have access to large stock of social capital, depending on the nature of those ties. Those with few social ties may thus have little access or opportunity to invest in social capital

Every island has a number of Governmental and Non-Governmental organizations. The Government level organizations are the Island Development Committee and Women's Development Committee.

There are about 51 NGOs covering a wide range of development and recreational activities in the ten islands at present.

Table 3.1: Registered clubs and societies in the study islands

REGISTERED CLUBS AND SOCIETIES (2007)	
ISLAND	No. CLUBS/SOCIETIES
KULHUDHUFFUSHI (HDH)	6
FUNADHOO (SH)	2
THULUSDHOO (K)	2
KUDAHUVADHOO (DH)	2
VILUFUSHI (TH)	3
GAN (L)	6
VILIGILI (GA)	8
THINADHOO (GDH)	9
HITHADHOO (S)	13
FEYDHOO (S)	5

Although there are a number of registered NGOs very few of them are active. Even the NGOs that are active reported that the activities of these organizations have reduced greatly over the last two years.

3.2.2 Trust and Solidarity

Measurement of trust seeks to assess trust towards neighbours, strangers, and government institutions, and how these perceptions have changed over time. In most of the empirical studies on social capital, trust in strangers is assessed from responses to the survey questions “Do you think that most people can be trusted or that you can’t be too careful in dealing with the people” and “Do you think most people would try to take advantage of you if they got a chance, or would they try to be fair?”. In the survey questions were asked to measure opinion on whether people who live on the island can be trusted; levels of trust on matters of lending and borrowing; the likelihood that a dropped wallet will be returned to owner without taking anything from it; one has to be alert or likely to be taken advantage of; how the levels of trust has varied over the last five years.

Trust as measured by the stated level of agreement that people who live on the island can be trusted was highest for Thulusdhoo (79%) and Funadhoo (79%) followed by Villingilli (78%). The level of generalized trust within island was lowest for Vilufushi (43%) and Thinadhoo (47%).

Financial trust in terms of lending and borrowing money was highest in Thulusdhoo (84%) and Kudahuvadhoo (80%). Trust in financial matters was observed to be particularly low in Kulhudhuffushi and Gan. When asked whether the island people generally trust each other in matters of lending and borrowing, only 25 percent agreed in Kulhudhuffushi, while 27 percent agreed in Gan.

The level of confidence with regard to personal property being returned is often the most accurate indicator of the level of trust in a community. When asked whether if someone would return a lost wallet or purse if dropped, Thulusdhoo scored exceptionally high with 79 percent of respondents agreeing. All the other islands scored relatively low on this indicator with less than 50% agreeing that the lost purse or wallet will be returned to the owner. Gan scored the lowest on this indicator with only 11% of respondents agreeing that the lost purse or wallet will be returned to the owner. The respondents often clarified their answer by stating that previously the wallet would have been returned but now with the presence of drug abusers who are known to be associated with theft they were unsure.

Trust as measured by whether people would try to take advantage of someone if they got a chance or would they try to be fair, Hithadhoo scores the lowest on trust but highest on the scale of taking advantage with 78 percent agreement, followed by Thinadhoo (77%), Gan (76%) and Villingilli (73%). Thulusdhoo has the highest level of trust (32%) followed by Funadhoo (50%) and Vilufushi (53%).

Levels of generalised trust in all the islands have worsened over the last five years. On average 72 percent of the respondents believed that the level of trust on the island has gotten worse over the last few years. In Kudahuvadhoo 84% of respondents stated that level of trust has gotten worse. The key reason for the low levels of trust is the high incidence of robbery and theft associated with the drug problem in the islands. A second reason is political divisions in the island attributed to political parties.

The feeling of community solidarity was gauged through asking whether a person would contribute money and time for a community project even if it doesn't benefit him or her. The sense of solidarity was found to be highest in Funadhoo where 93% of the respondents agreed that a person will contribute money to a project even if the project did not benefit him directly. Other islands with high community solidarity were Kudahuvadhoo (86%), Feydhoo (81%), Vilufushi (80%) and Thulusdhoo (79%). In these islands more than 75% of respondents believed that the people in the island would contribute to community interests ahead of personal interests. On the other hand, sense of community solidarity was found to be lowest in Hithadhoo where only 47% of respondents agreed that a person will contribute money to a community project that does not directly benefit him.

3.2.3 Volunteering

The scale and patterns in volunteering were determined using household questionnaires and consultations with Island Office. Volunteering is measured by asking if the person is a member of a voluntary organization, whether a person takes part in unpaid voluntary activity; whether they have donated money or time and if they have donated blood. The key findings are summarised below:

Membership of voluntary organizations was very low. More than 84 percent of the respondents reported that they did not belong to any organization. Membership in voluntary organisations was particularly low in Hithadhoo where only 5% of respondents reported membership. The next lowest is in Kuludhufushi where 8% reported membership. Membership in voluntary organizations was highest in Gan where one out of four respondents reported membership. The primary reason appeared to be the lack of information about organisations, activities and opportunities to become members. The NGOs themselves admit to not conduct any activities to increase registration. Most people interviewed appeared willing to participate but they appeared wary of most organizations due to the political alignment of their leading members. Usually, the most active members of the community are involved in political parties or at least sympathetic to certain parties. They are also the most likely groups to be active in leading voluntary organizations. Under such circumstances, political party members or their sympathizers may refuse to be involved in an organization led by an opposing political party member. Some neutral members of the community also cited the political alignment to avoid such organizations.

On the other hand, the proportion of people who participate in unpaid voluntary work is very high in most of the islands. The highest volunteering was found in Vilufushi where about 72 percent of people interviewed said that they regularly participated in unpaid voluntary work. The second highest volunteering was in Kudahuvadhoo where about 60% of the respondents reported they participated in regular unpaid voluntary work. Participation in unpaid voluntary work is lowest in Hithadhoo where only 6% engage in any voluntary work.

The proportion of people who donated money for voluntary activities over the past year was highest in Vilufushi with 57 percent, followed by Kudahuvadhoo (50%) and Feydhoo (50%). Donations were made mainly by middle income households. More females within the surveyed sample reported a donation. The lowest contribution was reported from Hithadhoo where only 15% reported a contribution.

Blood donation was comparatively low in all the ten islands, perhaps due to lack of need to donate blood as blood transfusions are rare in these islands. Highest blood donation was reported from Kudahuvadhoo with 23 percent respondents reporting donation to friends and other community members.

3.2.4 Political and Civic Participation

Political participation takes the broad view of social capital and is based on the concept of empowerment. Empowerment refers to the expansion of assets and capabilities of people to participate in, negotiate with, influence, control and hold accountable institutions that affect their lives. However, lack of proxies to measure empowerment forces to narrow down the focus to political participation alone. Political participation for the purposes of this study is measured by people attending public meetings; being involved in a political party; bringing issues to the attention of media; contacting Members of Parliament; talking to neighbours about issues facing the area and reporting to island office, courts or police about neighbourhood or island issues.

Over the last three years, several factors together have caused heightened political awareness and participation in political and civic activities. Some key contributing factors include, the registration of political parties in 2005, live telecasting of parliamentary debates, and the public referendum on the form of governance for the Maldives.

The level of civic participation is high. 57 percent of all respondents reported attending a public meeting over the last year. The attendance at public meetings is highest in Vilufushi with 81% of respondents having attended, followed by Funadhoo (67%). Attendance at meetings is lowest in Hithadhoo (44%) and Kulhudhuffushi (43%).

The level of participation in party politics was highest in Thulusdhoo with 58 percent of respondents stating active participation in a political party. Vilufushi had the lowest participation in political parties with 23% of respondents active in parties.

However, the level of participation, other than public gatherings, remained very low. Among the respondents 90 percent have never brought a problem to the attention of news papers, radio or TV. Perhaps this is due to lack of access to these facilities. There is very limited presence of media in island life. None of the islands have local newspapers or local radio stations.

The level of interaction with parliamentarians remained very low. About 85 percent of the respondents reported that they never contacted their member of parliament about an issue in the island. Most of them, particularly women, weren't even aware who their Member of Parliament was. However, there is an interesting difference in Vilufushi and Villingilli where 37% and 27% respondents respectively said they contacted their Member of Parliament. Perhaps this is due to the devastating impact of the 2004 tsunami in these islands.

One out of two respondents reported that they actively discuss with people in their neighbourhood on issues related to the island. About 79 percent of the respondents from Vilufushi reported having discussions with other people regarding problems or issues facing the community.

Most people do not report to the authorities on issues related to the neighbourhood or the island. Only 18 percent of the respondents notified to the court, island office or police about a

neighbourhood or island problem. Only seven percent of the respondents from Hithadhoo notified an issue to the court, island office or the police. This is an indication of the mistrust the population has on the government institutions to address island issues. In the case of Hithadhoo serious dissatisfaction with the Hithadhoo Office was highlighted by almost all the respondents.

3.2.5 Civic engagement, collective action and cooperation

Civic engagement refers to the extent to which citizens involve themselves in their communities. One of the positive manifestations of a high level of social capital in the community is the occurrence of frequent every-day social interactions. This sociability can take the form of meeting with people in public places, visits to other people's homes, visits from others into one's home and participation in community events such as sports, recreation, entertainment and ceremonies. Collective action is the indicator selected for measuring civic engagement. The usefulness of this indicator stems from the fact that in the vast majority of settings, collective action is possible only if a significant amount of social capital is available in the community. The major exception occurs in totalitarian societies where the government can force people to work together on infrastructure projects or other types of common activities. Thus, the validity of the collective action indicator as a measure of social capital needs to be evaluated against the political context of the society.

In the islands of the Maldives collective action is an important aspect of community life and consists primarily of community-organised activities for building and maintaining development infrastructure, provision of education, health care, environment protection and other public services. Unlike other countries, there is hardly any collective action that is politically oriented and used to lobby elected officials to provide more services to the community. This category explores whether and how people have worked with others in their community on joint projects and/or in response to a crisis. The selected proxy variables for collective action are: whether people contribute time to community projects that do not directly benefit them; whether people believe that by working together people in the island can influence decisions that affect the island; whether there are any community activities in which people are not allowed to participate and whether people believe that it is likely for people who do not participate in community activities to be sanctioned.

Civic engagement was found to be highest in Vilufushi and Kudahuvadhoo where 90% and 89% of the respondents respectively reported that people will contribute time to community projects that does not have direct benefits to the person. The lowest level of civic engagement was reported by Hithadhoo where 45% of respondents said that people will contribute time to community projects.

There is very high level of confidence in the islands (over 90 percent) that by working together, they could influence the decisions that affect the island. The confidence level reached 100% in Funadhoo, Thulusdhoo and Villingilli. The main challenge faced in civic engagement is recent political divisions. Respondents identified this as a hurdle to overcome if they are to work together for island development.

There was an element of mistrust towards the island administration, particularly role of island chiefs with regards to participation in community activities. In Hithadhoo and Kulhudhuffushi about 28 percent of people reported that there were community activities in which they were not allowed to participate. The response of island chiefs is that there is a wave of low civic engagement in all the islands across the Maldives and their respective island was not an exception. It was found that there

was not enough effort by island offices to inform the community about events and activities organised by the administration. The policy changes on the roles and responsibilities of IWDC and IDC, particularly on solid waste management and hospitality to visitors appears to have adversely affected civic engagement in many unforeseen ways.

More than 60 percent believed that they would not be sanctioned if they do not participate in community activities. However, they do feel that the community would look down upon them under such circumstances.

3.2.6 Social cohesion and inclusion

Five different questions were asked to gauge social cohesion and inclusion in the ten islands. On the question of the feeling of togetherness or closeness in the islands Thulusdhoo and Funadhoo scored the highest with 95 percent and 94 percent respectively. In Kulhudhuffushi no clear picture could be established with regard to the togetherness or closeness of the island. The opinions on the issue are strongly divided. When asked about how strongly they feel about the togetherness in the island, 47 percent agreed it was very close or somewhat close, and 40 percent disagreed. The opinion of respondents from Kulhudhuffushi was that recent political divisions have created serious rifts through the otherwise very closely knit community.

The respondents (93 percent) do not consider that there are religious divisions on the islands. They also did not believe there are any social issues associated with religious divisions in the islands. However, the community of Gan identified religious division as a potential emerging issue for the community. Some of the houses that were provided for the resettled community in Gan had to be altered because of perceived religious needs.

Although there are no serious religious divisions within communities, there is growing concern about 'extremist' elements creeping into the island communities. People are concerned about formation of small community groups who pray separately, who avoid mosques and prevent their daughters from attending school. The issue of dress code, particularly when the dress covers the entire body of a woman, including their face – has been considered as a dividing issue in otherwise harmonious communities.

Most people (69 percent of respondents) believed that there were no major differences between the wealthy and the poor. However, in Feydhoo 58 percent of respondents said there were divisions between rich and poor to a great extent or very great extent.

A high 82 percent of respondents also believed that there were no major differences in access to opportunities between men and women.

The rivalry and divisions between different wards and clubs were not an issue on eight of the ten islands. 87 percent of respondents were of the view there were no divisions. The exceptions were in Feydhoo where the opinion was divided fifty fifty and in Gan where 30 percent felt there were great social divisions caused by wards. Gan has three wards: Thundi, Mukurimagu and Mathimaradhoo and ward rivalry is very strong.

3.2.7 Wealth

There is not enough data to establish the personal wealth and their distribution pattern on the islands. The household surveys undertaken for the study showed that highest average income were in Villingilli and Thinadhoo at Rf 10,000 per month. The lowest reported average income was in Kulhudhuffushi at Rf5000 per month. The Vulnerability and Poverty Assessment of 2004 provides average income figures for these islands prior to the tsunami of 2004. Income figures will always need to be treated with caution as there is no simple method to triangulate and verify the stated incomes. The income figures often represent the lower end of total household income.

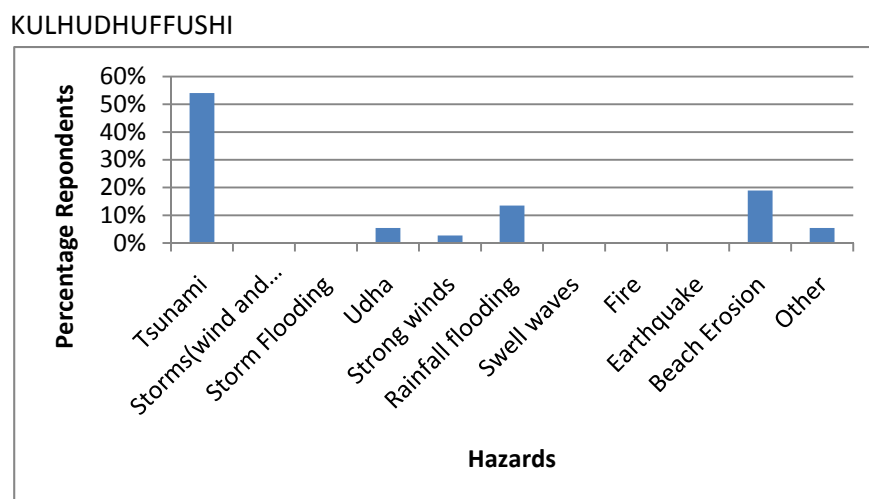
The survey questionnaire design had limitations in that it included the higher end of the income range at above Rf10, 000 per month. The highest end of the income bracket, particularly boat owners, wholesale and retail traders, and lead fishermen reported to receive incomes in excess of over Rf50, 000 per month. Future studies would need to take into consideration this finding.

Proxy indicators for wealth can be determined by using census and VPA data on density of commercial development, quality of housing and the size of the economy.

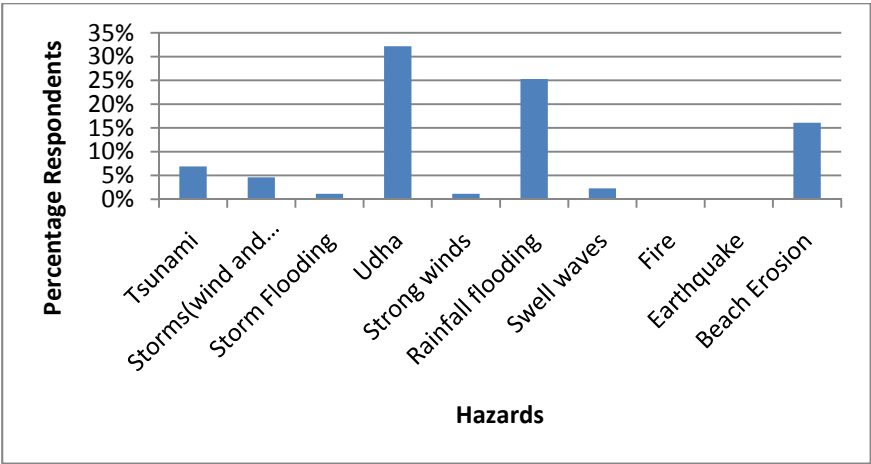
3.2.8 Perception of risks

In terms of the types of disasters, most people identify tsunamis, followed by udha, beach erosion, and rainfall flooding as major hazards. The following figures summarize risk perception in the ten islands. Risk perception varies by island.

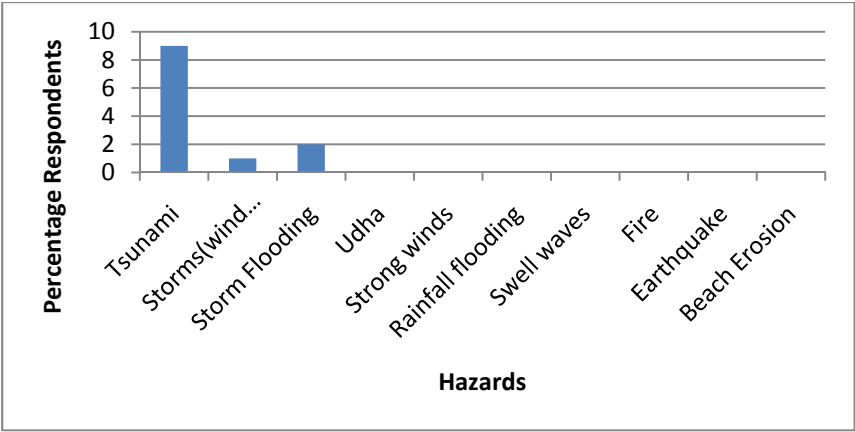
Figure 3.1: Perception of risk in the study islands



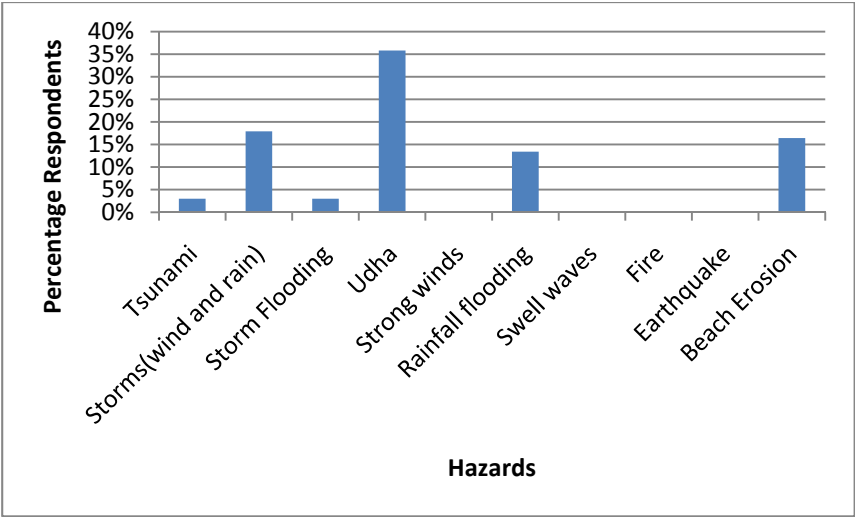
THINADHOO



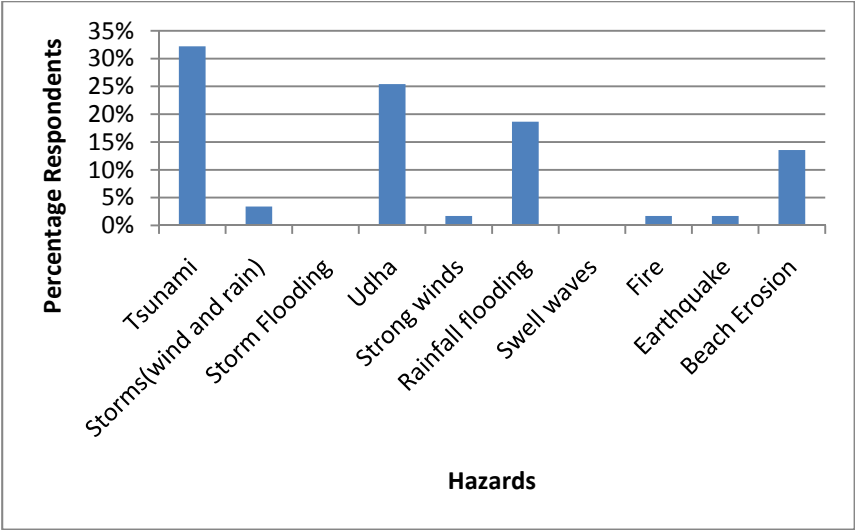
FUNADHOO



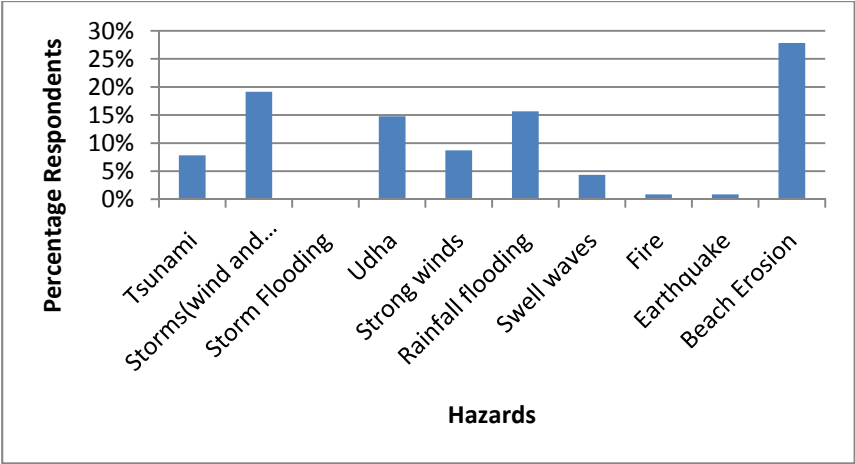
FEYDHOO



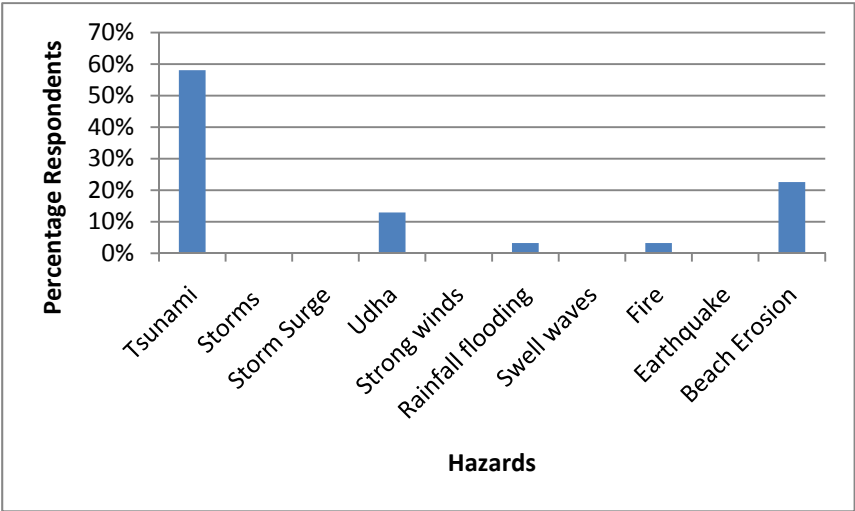
VILLINGILLI



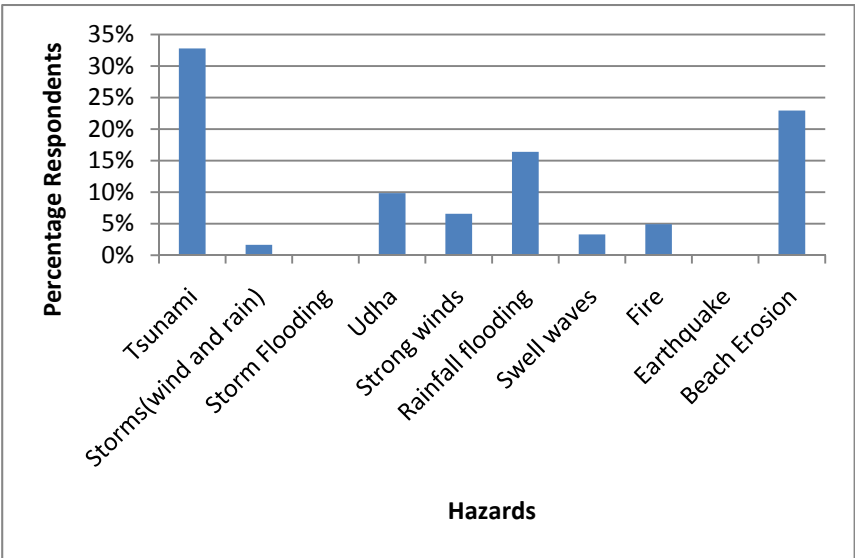
HITHADHOO



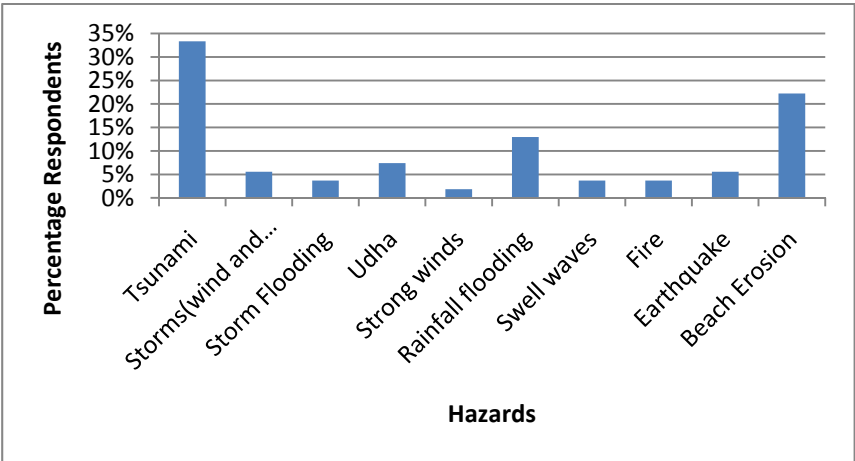
THULUSDHOO



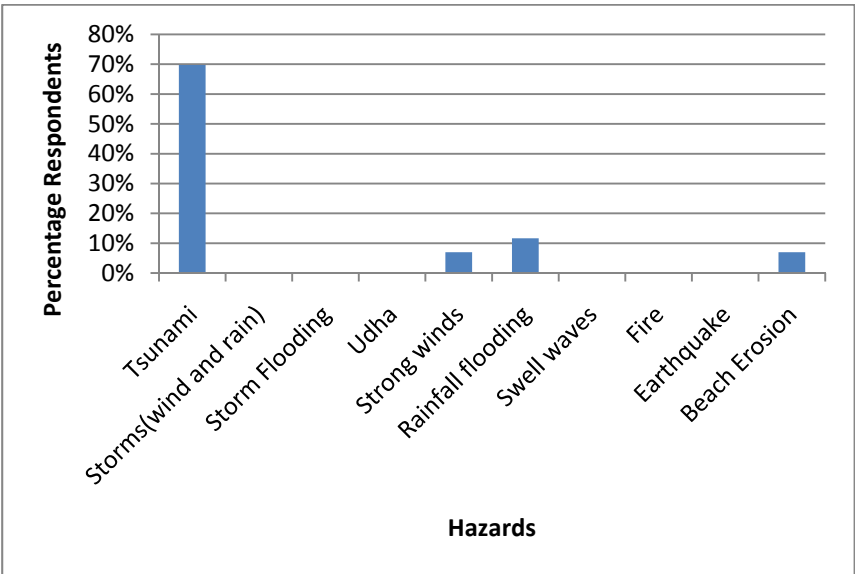
KUDAHUVADHOO



VILUFUSHI



GAN



The accepted level of risk varied amongst the various respondents. Most regarded small levels of risk such as erosion as unacceptable and wanted action taken to protect the shorelines. Some were very concerned with inconveniences such as rainfall flooding. Others were more interested in material losses and damage to property, particularly strong wind, tsunamis and heavy rainfall. Among the various groups, the fishermen were more concerned with damage to fishing vessels, fishing gear, harbour and their households. In general, most people seem to believe that risks on the island are moderate to low.

In general, the accepted risk also varied spatially. Transect walks revealed that coastal areas were more concerned about udha and flooding while inner island was mainly concerned with rainfall flooding and strong wind. Concerns over rainfall flooding were higher in islands like Thinadhoo, Viligilli and Kulhudhuffushi.

Most community organizations considered existing risks from coastal erosion very high and appeared to be in search for priority mitigation measures.

The perception of risks also had a religious influence in all islands with some people responding to questions on risk as an act of god which no one can predict or protect against. Most people had 'moderate' views on the subject and none objected to this study.

Perception of risks was also different between people with formal education and limited education. People with formal education tended to provide a broader list of hazards. Their views on mitigation measures were also more objective. The people with limited education provided a shorter list and most of them did not have clear view on the requirement for mitigation measures.

3.2.9 How they cope

Most people perceive that family, relatives and neighbours are the main groups that should provide assistance during a disaster. People also believe that Island Office and emergency services (police) should provide assistance.

Similarly most people believe that family, friends, relatives and neighbours will provide assistance to the household rather than the Government, Island Office or emergency services. This could essentially be described as the most likely coping strategy during a disaster event. It is unlikely that the emergency services, given its current capacity, will be able to respond to a disaster event when it strikes.

The coping strategy in daily life was observed to be first within the family followed by relatives, friends and neighbours. The household head, usually father supports the mother, and children support the parents, if needed. Occasionally, the poor households seek assistance from businessmen and politicians, if they have to incur expenditure beyond their means, particularly related to health. There is no social security setup or safety net except for those employed in the civil service.

There is overwhelming agreement that people in the island will help each other during a disaster event, regardless of any political, economic or social differences.

Household more frequently exposed to rainfall flooding hazard have adopted mitigation and coping strategies of their own. These include raising the entrance of the house, having emergency sand

bags, avoiding placing items on the kitchen floor during rainy days and placing brick along the side of the road to create a make-shift curb.

The community organizations are of the view that they would organise community cleanup and emergency help teams during such an event. They also believe that they would raise funds from the community to assist the most poor and severely affected households. However, the Island Office and IDC tend to believe that assistance from Central Government will arrive and that they would assist all those affected.

The poor households surveyed had no clear idea on how they would cope with a disaster. The discussion on such a scenario appeared to make them uncomfortable.

Most households believed that the Government would need to provide assistance in rebuilding the households if they are damaged. However additional querying revealed that they would look for self financing of rebuilding using savings and other investments, if they could afford it.

3.3 Potential Social effects of Disasters on the Community: High Magnitude Tsunami Event

3.3.1 Socio-demographic Impacts

The table below summarises the main impacts, their consequences on the community, groups affected and the coping mechanisms within the community. The information for this component was collected during household interviews, transect walks and stakeholder consultations, and enhanced using professional judgement.

Table 3.2: Summary of main socio-demographic impacts

Impact	Consequences	Groups Affected	Coping Capacity & Mechanisms
Loss of Life and injury to household member	<ul style="list-style-type: none"> - Socio-psychological changes to affected families and island population (fear, trauma, anxiety and changes in decision making). - Potential loss or injury of bread-winner affecting the economic well-being of whole family. - Decline in economic productivity. 	<p><u>Most Vulnerable:</u> Children under the age of 9, particularly toddlers; elderly; physically and mentally disabled; foreign workers; police (emergency workers); households with large number of dependents.</p> <p><u>Other Vulnerable Groups:</u> All Others</p>	<ul style="list-style-type: none"> - Support from family members and relatives - Support from neighbours - All other community members - Good hospital facilities may reduce fatalities.
Disease and Epidemics	<ul style="list-style-type: none"> - Decline in well-being of the whole community. - Health services overburdened particularly if health facilities are 	<p><u>Most Vulnerable:</u> all children; elderly; physically disabled</p> <p><u>Other Vulnerable Groups:</u> All Others</p>	<ul style="list-style-type: none"> - Hospital services - Local medicine practitioners - Support from family members and relatives

Impact	Consequences	Groups Affected	Coping Capacity & Mechanisms
	<p>damaged.</p> <ul style="list-style-type: none"> - Affects on household heads and subsequent well-being of the whole family. - Decline in economic productivity - Slow-down of recovery assistance by individuals. 		<ul style="list-style-type: none"> - Support from neighbours - Emergency medicine supplied by Government. - All community members – cleaning up the island.
Loss or damage to house and, kitchen and toilets (usually separate units).	<ul style="list-style-type: none"> - Homelessness - Socio-psychological changes to affected families and island population (fear, trauma, anxiety and changes in decision making). - Psychological issues related to living in temporary shelters and due to loss of household routines. - Various forms of potential abuse when living in temporary shelters. - Decline in productivity (particularly basic sectors) as working age population is involved in rebuilding - Decline in expenditure on non-essential aspects and reduced savings during reconstruction. - Inability to reconstruct due to lack of savings, particularly in low income households. 	<u><i>Most Vulnerable:</i></u> Low income households; female headed households; households with many dependents; households close to coastline; old houses; physically and mentally disabled; foreign workers;	<ul style="list-style-type: none"> - Savings and capital assets. - Support from family members and relatives - Temporary housing provided by relatives, neighbours and other community members. - Temporary housing provided by Government. - Wealthy community members - Government reconstruction programmes - International aid - Temporary relocation to other islands, particularly Male'.
Loss or damage to household goods and personal belongings	<ul style="list-style-type: none"> - Loss of cash and valuables, usually stored in households. - Decline in expenditure on non-essential aspects and 	<u><i>Most Vulnerable:</i></u> Low income households; households close to coastline; households not using bank services. <u><i>Other Vulnerable Groups:</i></u> All	<ul style="list-style-type: none"> - Savings and capital assets. - Support from family members and relatives - Wealthy

Impact	Consequences	Groups Affected	Coping Capacity & Mechanisms
	reduced savings.	<u>Others</u>	community members
Loss of productive assets – backyard agriculture, rope making facilities and fishing vessels.	<ul style="list-style-type: none"> - Unemployment and loss of income in the short to medium term. - Decline in productivity. 	<u>Most Vulnerable:</u> Women; female headed households; low income households; households with a single source of income; key economic groups – fishermen, backyard manufacturing and agriculture.	<ul style="list-style-type: none"> - Savings and capital assets. - Support from family members and relatives
Reduced access to lifeline services	<ul style="list-style-type: none"> - Loss of electricity leading to poor mobility during night, particularly for recovery. - Damage to health facilities reducing the capacity of health services. - Damage to harbour and port affecting supplies, particularly food, medicine and construction material. - Damage to sewerage system leading poor hygiene and health issues. 	<u>Most Vulnerable:</u> Female headed households; households with physically and mentally disabled persons; households with many dependents.	<ul style="list-style-type: none"> - Support from family members and relatives - Support from NGOs, WDC and other community organizations - All community members
Reduced food security	<ul style="list-style-type: none"> - Shortage of essential food items due to damage to warehouses and retail shops. - Damage to subsistence crops and open field crops further reduce domestic food supply. - Shortage of foods due to damage to transport vessels and harbour. 	<u>Most Vulnerable:</u> Female headed households; households with many dependents; low income households	<ul style="list-style-type: none"> - Support from family members and relatives - Support from neighbours - General support within the community - Support from nearby islands. - Government aid
Reduced fertility of land and loss of back yard	<ul style="list-style-type: none"> - Shortage of some food items - Decline in agricultural activity 	<u>Most Vulnerable:</u> Women, Female headed households; Farmers.	<ul style="list-style-type: none"> - Support from family members and relatives - General support

Impact	Consequences	Groups Affected	Coping Capacity & Mechanisms
trees	and back yard food production and processing.		within the community - Support from nearby islands. - Government aid
Reduced access to education	- Students from nearby islands studying in Kulhudhuffushi may need to temporarily return to their home island. - School closure	<u>Most Vulnerable:</u> school age children; migrant students.	- Support from family members and relatives

3.3.2 Factors enhancing the effects of a Disaster

1. Housing location: Houses with most vulnerable groups are located in severe hazard zones, close to the coastline.
2. Poor housing design and construction: The poor structural design and construction methods expose a number of houses to severe damage.
3. Storage of cash in households: Savings are generally stored in the households. Only the major businessmen regularly store cash in the bank. Valuables are always stored in the house. These practices expose the valuable and savings in the households within hazard zones.
4. Schools are located in hazard zones which will exacerbate the effects of a disaster if it occurs on a school day.
5. Hospitals are located close to the coastline in severe hazard zones. This will have a significant effect during disaster situation and in post disaster recovery processes.
6. Women's income earning activities are at risk when the houses are exposed to damage. They are likely to recovery slowly due to low income and family care responsibilities.
7. Major productive economic assets are concentrated in coastline which is exposed to severe impacts.
8. Inadequate water supplies when rainwater tanks are damaged and ground water is saline.
9. Inadequate storage of food supplies in islands and at regional level.
10. Poorly designed lifeline infrastructure – harbour, hospital, power house, powerlines and sewerage network.
11. Lack of trust with the administrative authorities; the political change process have reduced their credibility.
12. Political differences: As noted above, there may be hindrances to community organization as time progresses in recovery activities.
13. The dependent population on the island, particularly children, are quite high.

3.3.3 Factors reducing the effects of a Disaster

1. Strong community organization at time of a disaster.
2. Strong ties with family, relatives, neighbours and community generally enhance the coping mechanisms of individual households.
3. Smallness of the community: The social networking within the communities are strong and the fact that most people know each other leads to immediate identification of most vulnerable households. Community response during a disaster is likely to benefit with such knowledge.
4. The population of safe islands have above average household incomes. Their ability to absorb losses appears to be slightly high due to the community based safety nets and contributions from wealthy businessmen. However, significant impacts on the key employers and businesses are likely to reduce this advantage.
5. Potential increase in prosocial behaviour: material and financial donations, reduced incidence of antisocial behaviour and engagement of unemployed youth may assist in the recovery in the short term.

3.4 Measures to reduce social vulnerability to disasters

3.4.1 Risk reduction and management

1. Diversifying the economy and providing additional economic activities to improve the economic well-being of the community. Wealth enables communities to respond and recover from losses more quickly through additional recourses, community contributions, savings and other community level social safety nets. A reduction in the number of poor households may also lead to better, more resilient, structures throughout an island.
2. Sharing the burden of risk through insurance: Insurance is almost non-existent in the islands. Insurance should be encouraged for high risk establishment, particularly key employers.
3. Social safety nets should be established to cover all members of the community, particularly the most vulnerable groups – elderly, female headed households and disabled persons.
4. Land use regulations and building codes should be redeveloped by taking hazard resilience into account.

3.4.2 Mitigation

1. There is a need to make the lifeline infrastructure, mainly harbours, power and hospital more resilient.
2. Construction of evacuation centres or enhancement of existing evacuation centres like schools and community halls.
3. Making houses more resilient to flooding, particularly those houses within severe hazard zones.
4. Establishing mitigation measures for key employers and business establishments (see economic assessment above).
5. There is also the need to relocate the pre-schools and schools that are located in high risk zones.
6. All future land use planning shall have disaster risk mitigation as a key strategy for planning.

3.4.3 Preparedness

1. Risk communication is the most essential element of preparedness. It was found that disaster perception is very different in the islands that were impacted by the tsunami compared to those that were not impacted much. The knowledge and awareness of the public is the most critical tool for disaster preparedness. The findings of DHIRAM need to be conveyed to the 10 island communities as a priority action.
2. None of the islands surveyed had proper disaster management plans. Even if disaster management plans may have been developed with donor assistance in the islands, the public was not aware of such plans and there is no solid implementation of plans. Hence there is a need to develop disaster management plans for the ten safe islands as a priority. In each island a specific team with specific roles need to be identified to facilitate a smooth response during disasters.
3. Early warning system appears crucial for high impact events. The disaster management plan in the islands should be complemented with a nationwide early warning system.
4. Special attention needs to be paid to integrate the foreign population into social activities carried out at island level. At present they are marginalised from most social or community activities.
5. A registrar of temporary residents, particularly foreigners, should be developed and maintained by each Island Office.
6. Food and water security is crucial at times of a disaster. Sufficient basic food stocks need to be maintained on the islands for at least two weeks. The State Trading Organization (STO) could be asked to establish food storage in all ten safe islands. Two elements of water security are evident following the recent water shortages: first enhancing the capacity to harvest rainwater and strengthening the rainwater tanks against flood impacts; second providing desalination plants for emergency water production.

3.4.4 Response & recovery

1. Hospitals need to be protected against flooding impacts to improve emergency response.
2. The police stations in these islands need to be equipped with emergency response facilities, particularly flood response.
3. In all islands there is a need to reduce community divisions, particularly political divisions to improve the response and recovery from disasters. This will include renewing community activities like festivals and special celebrations. Such activities should not be politicised or based along party lines.
4. In the larger islands there is a need to develop a core or heart of the island. This issue is particularly acute in Hithadhoo where there is no space for social networking. In islands like Kulhudhuffushi there is an informal core area where people meet – the harbour area. This informal setup should be maintained and encouraged to develop social networking.
5. Social networking should be improved among Government agencies and establishments in all islands. Fragmented decentralisation by ministries such as health, education, family and police has created organisations in islands that are not fully co-operative with each other. The co-ordination and reporting requirement does not ensure interaction amongst these agencies to the desired level at the island level.

6. It is recommended that a disaster contingency fund be established in the national annual budget.

3.4.5 Changes in governance

On 11 November 2003, the President of Maldives declared the need for a democratic reform agenda to support democratization efforts, enhance governance systems, and modernize public services in the country. In 2006, the “Roadmap for Reform Agenda” was launched. Under the reform agenda several important institutional reforms have taken place such as the establishment of the Human Rights Commission of the Maldives; enabling of multi-party politics through providing regulatory framework for registration and functioning of political parties; establishment of the Judicial Services Commission; ratification of a Civil Services Act; establishment of an independent Auditor General’s Office; and the ratification of a new Employment Act. The pinnacle of the reform process was the adoption of a new Constitution of the Maldives on 7 August 2008. Under the new constitution the first ever multi-party presidential election was held in 2008 and a new president was sworn in on the 11th of November 2008.

While remarkable progress has been achieved in reforming the national level institutions, inadequate attention has been given to local governance. Although drastic changes have been proposed to the island and atoll governance system, including the election of island councillors and island councils they have so far been appointed by the Government. The statements and actions of political parties have brought discredit to the leadership in many island communities. Serious divisions also exist between members of the newly formed political parties. The presidential election campaign and the parliamentary election campaign have made the divisions worse. It is anticipated that the divisions although deep will be temporary, between community members and even within family units.

The lack of due attention to local governance system has noticeably started to erode the trust public has in local institutions, particularly island and atoll offices. In all the ten islands, the public expressed dissatisfaction with the existing island office achievements and the officials who are in leadership positions in the offices. The eroding trust in island offices to govern the islands has started effecting negatively on social norms and customs such as respect to one another within the community. The norm of respect to elders and the leaders of the community are also slowly eroding. The welcome and hospitality extended to visitors to an island are also diminishing.

From a disaster impact mitigation and recovery perspective the emerging trends in the island are considered highly challenging. Trust in the leadership of the community is essential for collective action and to co-ordinate operations. Special efforts are needed to reverse the process of declining trust in island level institutions.

3.4.6 Drug abuse and anti-social behaviour

Drug abuse has been identified as the single biggest social problem facing the islands. The scale of the problem varies from island to island. In Hithadhoo, Feydhoo, Villigilli, Thinadhoo and Gan drug abuse has reached critical levels and authorities are finding it impossible to contain the problem. In Funadhoo, Kudahuvadhoo and Thulusdhoo the authorities are able to control the problem and the issue is managed well. Kulhudhuffushi used to be drugs free in the recent past but now more and

more youth are entering the drug cycle with knock on effects on a number of social aspects in the community. Associated with drug abuse are violence, theft and arson. Moreover, a large number of youth are spending a large proportion of their income on drugs. This is particularly serious in Villigilli and Thinadhoo where reportedly the young fishermen are engaged in drug abuse. There is generalized mistrust between the general community members and drug users. As a result, the drug addicts form a marginalized group of young people in a community. They find it difficult to get stable jobs.

A key finding of this study is that drug abuse is the most serious social development problem facing the nine islands. If this issue is not tackled then the social resilience of the islands will diminish at a rapid pace and the capacity to absorb shocks to the social system will become very low. In such a situation it will be very difficult to undertake disaster impact mitigation and disaster recovery operations.

4 Conclusions and Recommendations

1. One the fundamental issues identified in the island economic system is the narrow economic base and vulnerability of basic sectors to severe losses during high magnitude events. Under these conditions, the non-basic sectors appear to decline dramatically and are supported largely by income from Civil Service. Hence, diversification of the local economy is recommended as an important step in making these islands economically resilient. Activities which export goods and services to entities other than the Government is essential to promote economic growth. Wealth enables communities to respond and recover from losses more quickly through additional recourses, community contributions, savings and other community level social safety nets. A reduction in the number of poor households may also lead to better, more resilient, structures throughout an island. The Government programme for corporatisation of utility services and changes in the Governance System is a step in this direction. The following options could be considered based on the island setting and human resources:
 - a. Expansion and more direct involvement in the tourism sector, particularly in transport, servicing and resort supplies.
 - b. Organised development of the local construction industry to service outside the island.
 - c. Expansion and specialisation in the boat building sector with facilities that could provide an edge over other islands – for example, constructing a slipway.
 - d. Organised development of the fish processing activities with modern technologies and to international standards.
 - e. Expansion into the tertiary sector.
 - f. Specialization and collectivization of agriculture. At present the production levels are at subsistence level with no specialization, leading to poor quality of produce and reduced prices due to strong competition within the local economy. It may be more efficient and profitable if sections of the community could form cooperatives, commercialise the farms, specialise and export to other islands (mainly resorts and Male') in a more organized manner. Gan is a prime example where fragmented farms and small scale production has failed to make the industry more profitable for the local economy.
 - g. Pay special attention to establish communication, transport, banking and finance related economic activities in larger islands such as Hithadhoo and Kulhudhuffushi.
 - h. Introduce education and health as economic opportunities through establishment of higher education facilities and better medical services in the safe islands.
2. The lifeline infrastructure on most island need to be made more resilient as an urgent measure. The most critical facilities are listed in the table 3.3 below.

Table 3.3: Lifeline infrastructure requiring urgent mitigation measures

Island	Lifeline infrastructure
Kulhudhuffushi	Powerhouse, harbour and hospital
Funadhoo	New Powerhouse
Thulusdhoo	Communications facilities
Kudahuvadhoo	Powerhouse
Gan (Mathimaradhoo)	Powerhouse, Communications facility
Gan Mukurimagu	Powerhouse
Viligilli	Atoll hospital
Thinadhoo	Powerhouse, hospital, harbour
Feydhoo	Addu Link Road
Hithadhoo	Powerhouse, Link road

3. The oceanward coastline of Thinadhoo, Gan (Mukurimagu) and Feydhoo needs to be protected as an urgent action. Coastlines of Hithadhoo, Kulhudhuffushi and Kudahuvadhoo do not require immediate protection.
4. Risk communication should be a priority action to enhance preparedness and awareness in risk reduction. The findings of Disaster Risk Profile of Maldives and DHIRAM study needs to be urgently disseminated through workshops and community presentations in all the study islands.
5. Disaster management plans should be developed as a priority action. Such plans should be developed by the community and facilitated by specialists. This will increase the ownership of the plan and ensure they are strongly island specific. Mechanisms should be established to review and renew the plans to ensure continuity and increase awareness on hazard risks.
6. The basic economic sectors (fisheries, agriculture, etc..) are highly vulnerable to coastal flooding hazards. Damage to these sectors ensures that recovery is slow and socio-economic impacts are exacerbated. Resilience of these sectors is essential to recovery of the communities. Measures to improve their resilience include encouraging and facilitating insurance, resilient harbour and timely delivery of Government stimulus packages following a disaster.
7. An early warning system needs to be in place as a matter of urgency.
8. It is clear that exposure to hazard risk in most islands are partially the result of improper coastal developments and land use. Land use planning guidelines need to be redeveloped to include hazard resilience as a key objective. Development within a certain distance from the coastline should be prohibited in all islands and existing structures should be encouraged to move to safer locations. Building codes need to include elements of hazard resilience as well. Development within a known hazard zone should be subject to more stringent building codes to ensure they are resilient to at least the moderate magnitude events. Environmental Impact Assessment (EIAs) should have mandatory evaluation of hazard risks, particularly for all coastal development projects. Land reclamation guidelines need to be developed and adhered to avoid unnecessary economic losses in the future.
9. A campaign to promote the use of banks to store savings and cash, particularly in islands with banking facilities, needs to be undertaken. This could improve the safety of savings during disaster events and improve economic growth.

10. Integration of disaster risk reduction and climate change adaptation with development programmes need to be undertaken at a more explicit level. A number of development programmes already have disaster risk reduction included in them, following the tsunami of 2004. These include harbour development and communications facilities development. The integrated approach should be extended all new public infrastructure, economic development initiatives and social protection schemes. The present Governments concept of 'resilient settlements' with an inherent shift of focus from physical protection to societal and economic resilience is a welcome step towards this direction.
11. Disaster recovery efforts should focus, wherever possible, on providing job opportunities and income to the local community rather than leaking the money out of the local economy by handing out contracts to construction companies outside the island. The tsunami reconstruction activities on Gan, Viligilli, Thulusdhoo, Funadhoo and Vilufushi are testament to this process. Contracts for these islands were awarded to companies based in Male' or foreign companies who hired cheap foreign labour. The only financial input into the local economy was through servicing the workforce, namely from rental income and retail sector. Cooperatives of island communities could be considered for reconstruction activities in the future, where possible.
12. Hard engineered mitigation structures, particularly coastal protection appeared infeasible for most islands in the short-term given the lack of high magnitude events. The cost-benefit analysis, based purely on an economic perspective, suggests such structures are infeasible in the short term. Moreover, the potential need for future island expansion also means that a fixed coastal protection system, like Vilufushi, is going to be a hindrance and ultimately a 'wasted' investment. Instead, the present Government's concept of "resilient settlements" should be promoted with equal or more emphasis on societal and economic resilience. Of course, there are three islands, as noted above, which needs immediate coastal protection.
13. Drug abuse appears to be the main menace to social capital in the islands. This issue needs to be tackled as the top national development priority. Addressing drug abuse shall be integrated into all economic, physical and social development agendas such as education, health, housing, employment, transport and sports.
14. The Maldives is still at the infant stage of multi-party democratic governance. The values and principles that should underpin democratic governance are at this stage compromised to win seats in parliament and increase the support base of political parties. As a result, strong political divisions are being created in cohesive communities and this if goes unchecked could have adverse consequences on the communities in the short and long term. It is recommended that the leadership of political parties are educated and informed about the consequences of their actions on the main social assets of the Maldives: unity, social cohesion and reciprocity.
15. There is a need to speed up the enactment of the law on decentralization. Once the law is enacted and elections are held for the island councils and atoll councils, an intensive capacity building effort would need to be conducted in the islands for the elected councilors and the island administration staff.
16. Disaster risk reduction and disaster impact management shall form an integral part of capacity building activities for island level local governance.

17. Community events and activities are essential to maintain and rebuild social relations. Hence it is recommended that special effort be undertaken to organize events to celebrate Eid, National Day, Independence Day and other events where everyone would feel belonging.
18. Although there are more than 51 registered NGOs in the safe islands very few of them are active. Special effort needs to be undertaken to strengthen NGOs through well planned capacity building efforts. More than 84 percent of the respondents reported that they did not belong to any organization. Hence, NGOs need to be encouraged to undertake membership increasing efforts.
19. Hithadhoo scored low on all aspects of social capital. One possible reason for this could be the physical setting of Hithadhoo as a long and narrow island where travel and interaction is very difficult. In larger islands there is a need to create a core/heart which will draw people together and provide space for interactions. Community centres, pre-schools, shopping precinct, sports and recreation opportunities can be situated in the heart of island to enhance the core effect.
20. With the introduction of the new governance structure of the Maldives through the 2008 Constitution, there is a need to redefine the role of politicians, particularly MPs and elected officials in the islands. There is a total detachment of MPs from their constituents throughout the five years after election. MPs shall be enabled and encouraged to visit their constituencies and listen to the opinion and views of the communities.
21. Insurance enables sharing the burden of risk. Buying insurance is almost non-existent in the safe islands. There is an immediate need to educate the communities on buying insurance and the insurance services available in the country. To set the example, the Government shall initiate insuring high risk public establishments such as hospitals, schools and power houses.
22. The government efforts to establish adequate social safety nets should be encouraged and expanded to cover all members of the community, particularly the most vulnerable groups – elderly, female headed households and disabled persons.
23. A shift in the present infrastructure and development practices are required for the new 'resilient communities' concept. Stringent risk reduction guidelines need to be established for all infrastructure located in high risk zones. This is likely to ensure that mitigation measures are incorporated in all major development projects. The Government should adhere to strict land use planning guidelines (discussed above) to locate critical infrastructure away from high risk zones. Where unavoidable, these facilities should have risk reduction measures integrated and financed at the planning stage. Poorly engineered structures should not be allowed in high risk zones.

4.1 Recommendations for future study

This study has identified and established a methodological framework to undertake a comprehensive assessment social and economic vulnerability to disasters in Maldives. The study is, still, by no means the most comprehensive and a lot remains to be done. As noted in DHIRAM1 the methodology presented here is a starting point for further enhancement. The recommendations for future study are as follows:

1. Increase the sample size for household surveys and business establishment surveys.

2. More detailed assessment of the root causes of widespread divisions in most of the islands as noted in the study.
3. Extensive community involvement in the research process so that the study is more localised they could learn from the process as well.
4. Acquire access to household level data from Census to undertake community vulnerability mapping. The Department of National Planning informed that the household data cannot be plotted on a map due to privacy issues. Without the census data it takes a lot of time to establish the most vulnerable households and is subject to numerous inaccuracies. Therefore, a mechanism needs to be established where census data could be located at household level, without compromising the privacy issues. This has been done in a number of other countries.
5. There is also a need for more accurate basemaps of the study islands, particularly GIS maps.
6. The findings may also need to be verified further since, due to data limitations, many conclusions were made based on expert judgement.
7. More detailed analysis of mitigation measures need to be undertaken. The authors are not engineers and therefore some of the mitigation options suggested in this report should be treated as suggestions and explored in more detail by experts.
8. Time series data and panel data are essential for better disaster management planning. Time series data will show whether vulnerability is increasing or decreasing over time in the selected islands. On the other hand, household panel data will show how most vulnerable households in an island are performing in terms of reducing exposure and enhancing resilience. It is recommended that the survey be repeated in five islands every two years.