

Faculty of Humanities

**Perception, Vulnerability, and Adaptation to Climate Change
Impacts: A Case Study of Coastal Livelihoods in Chilaw, Sri
Lanka**

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This thesis is presented for the Degree of

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The proposed research study received human ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number # RDHS-14-15.

Abstract

This study examines three prime concepts associated with climate change impacts: perception, vulnerability and adaptation in relation to coastal livelihoods in Sri Lanka. Often ignored, perception is an integral cognitive element in the process of decision making that significantly influences the ultimate state of vulnerabilities and adaptations of households and is thus given due recognition in the study. This resulted in both subjective and objective measurements of livelihood vulnerability that facilitate a holistic view of barriers to performing sustainable adaptation measures to combat context-specific climate scenarios. Vulnerability is calculated premised on the most commonly accepted definition by the Intergovernmental Panel on Climate Change (IPCC) that views it as a function of exposure, sensitivity and adaptive capacity. Accordingly, objective measurements are acquired through a Livelihood Vulnerability Index (LVI) while subjective judgments on the degree of vulnerability are assessed by Perception Indexes (PIs). For that, a household survey of 206 participants was conducted. The underlying causes of the calculated vulnerabilities and reasons for respective adaptive behaviours were revealed through 47 in-depth interviews with the selected participants in the surveys. Qualitative measurements based on 20 key-informant interviews and five focus group discussions are also employed to understand the context.

Five villages in Chilaw Divisional Secretariat (DS) in north-western Sri Lanka, namely Kurusapaduwa, North Weralabada, South Weralabada, Egodawatta and Weralabada, located in between a lagoon and the sea, are defined as the case study for the analysis. The results suggest that Kurusapaduwa may be more vulnerable in terms of exposure, food, shelter, and sociodemographic structure while North Weralabada may be more vulnerable in terms of sociopolitical networks. Comparatively, Weralabada recorded the lowest vulnerability to climate change impacts. In addition, the study reveals several physical, structural, and cognitive barriers that hinder adaptation to climate change impacts which could be assisted by informed policies. The holistic view of vulnerability informed by the study is expected to work as an eye-opener, particularly in its specific context where related previous literature is absent and climate change is perceived as a novel, abstract, and distant concept, although its repercussions are suggested and visible.

This study reveals the significance of dynamic psychological, cultural, social, economic, and political factors strongly influence both the impacts of climate change and their resolution, in addition to the scientific discoveries specific to climate science. Accordingly, it demonstrates the need for effective governance procedures that ensure enforcement of existing laws, and encompass policies that respect and acknowledge local beliefs, knowledge, and perceptions in addition to scientific descriptions. Overall, the study contributes to the theory of vulnerability in its objective and subjective forms, while in the practical realm it emphasises the need for interdisciplinary policies that address climate change impacts along with other political and economic priorities of coastal livelihoods. It also offers insights for other similar coastal communities.

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Copyright statement

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Acknowledgement of Country

We acknowledge that Curtin University works across hundreds of traditional lands and custodial groups in Australia, and with First Nations people around the globe. We wish to pay our deepest respects to their ancestors and members of their communities, past, present, and to their emerging leaders. Our passion and commitment to work with all Australians and peoples from across the world, including our First Nations peoples are at the core of the work we do, reflective of our institutions' values and commitment to our role as leaders in the Reconciliation space in Australia.

Dedication

I dedicate this thesis to the three most beautiful and adorable ladies in my life:

My late “Amma” (mum), the symbol of love, courage, and wisdom, the woman who inspires me every day, even after her passing away.

My two blissful daughters, Himadi and Tharudi, who fuel my life with everyday happiness.

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Glossary of Terms and Acronyms

ADB	Asian Development Bank
AMS	American Meteorological Society
CBA	Community Based Adaptation
CBD	Convention on Biological Diversity
CBOs	Community Based Organisations
CBT	Competency Based Training
CC	Climate Change
CCD	Coast Conservation Department
CCGA	Climate Change and Global Affairs
CCS	Climate Change Secretariat
CDSRP	Chilaw Divisional Secretariat Resource Profile
CEA	Central Environment Authority
CFC	Ceylon Fisheries Corporation
CFHC	Ceylon Fishery Harbour Corporation
CGD	Commission on Growth and Development
Chilaw DS	Chilaw Divisional Secretariat
CPA	Coastal Protection Authority
CZMP	Coastal Zone Management Plan
CPI	Corruption Perception Index
Deshagunika Wiparyaasha	Climate Change
DFAR	Department of Fisheries & Aquatic Resources
DFID	Department for International Development

Diyakada	Ocean current/ Sea current
DMC	Disaster Management Centre
EbA	Ecosystem Based Adaptation
EDOs	Economic Development Officers
FAO	Food and Agricultural Organisation of United Nations
FCSs	Fisheries Cooperative Societies
FGDs	Focus Group Discussions
FIs	Fisheries Inspectors
GCCMs	Global Climate Change Models
GCF	Green Climate Fund
GEF	Global Environmental Facility
GIS	Geographical Information Systems
GN	Grama Niladhari
GNDs	Grama Niladhari Divisions
HDI	Human Development Index
IDS	Institute of Development Studies
IIRR	International Institute of Rural Reconstruction
IMF	International Monetary Fund
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPs	Institutions, Policies and Processes
IPS	Institute of Policy Studies of Sri Lanka
Kaalagunaya	Weather
KAP	Knowledge, Attitude, and Practice

KI	Key Informant
KIIs	Key Informant Interviews
LDCEG	Least Developed Countries Expert Group
Lunu Kasuwa	Wind filled with salt / salty sea spray
LV	Livelihood Vulnerability
LVI	Livelihood Vulnerability Index
MENR	Ministry of Environment and Natural Resources
MEPA	Marine Environment Protection Authority
MFAR	Ministry of Fisheries and Aquatic Resources
MHWL	Mean High Water Line
MLWL	Mean Low Water Line
MMDE	Ministry of Mahaweli Development & Environment
Moya kata	Inlet of a lagoon
MPPACC	Model of Private Proactive Adaptation to Climate Change
MTE&WA	Ministry of Transport, Environment, and Women's Affairs
NACCC	National Advisory Committee of Climate Change
NAF	National Adaptation Fund
NAFSO	National Fisheries Solidarity Organization
NAP	National Adaptation Plan
NAPCLD	National Action Programme for Combating the Land Degradation of Sri Lanka
NAQDA	National Aquaculture Development of Authority
NARA	National Aquatic Resources Research and Development Agency
NARP	National Agriculture Research Policy

NAS	National Adaptation Strategy
NCCP	National Climate Change Policy
NCSA	National Capacity Needs Self–Assessment
NEP	National Environment Policy
NHP	National Housing Policy
NIFNE	National Institute of Fisheries and Nautical Engineering
NP&SCP	National Policy and Strategy on Cleaner Production
NPP	National Physical Plan
NRC	National Research Council
PA	Precautionary Approach
PHI	Public Health Inspector
PI	Perception Index
PIs	Perception Indexes
PMT	Protection Motivation Theory
PMU	Project Management Unit
PP	Precautionary Principle
PRC	Pew Research Centre
PTRS	Philosophical Transactions of the Royal Society
RA	Research Assistant
SAM	Special Area Management
SCM	Stages of Change Model
SCT	Socio Cognitive Theory
SLA	Sustainable Livelihood Approach
SLCDMP	Sri Lanka Comprehensive Disaster Management Programme

SLR	Sea Level Rise
SLWDP	Sri Lanka Water Development Report 2010
TI	Transparency International
UN	United Nations
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
VAs	Vulnerability Assessments
Waadiya	A Hut
WB	The World Bank
WCED	World Commission on Environment and Development
WRI	World Resources Institute
WSWS	World Socialist Web Site
Yeththuwa	Wind

Chapter 1. Introduction

1.1 Introduction

This chapter outlines the constituents of the overall thesis. Section 1.2, thesis rationale, presents the existing gap in the research while Section 1.3 introduces its main research question and sets objectives through which we attempt to fill the gap. Section 1.4 contains brief justification of the selection of the case or the context within which the study took place. It further outlines the methodological aspects employed to investigate the phenomena of concern. Theoretical considerations are briefly outlined in Section 1.5, and the fundamental approach that guides the study is stated. Section 1.6 states the significance and novelty of the research to both the theoretical realm and practical realm. Finally, Section 1.7 introduces the chapters, their order, content, and relevance to the research objectives. Due to the lack of recent research, some citations and statistics in this chapter are outdated. This was a hindrance in understanding the peoples and climate of the area. However, this gap in literature further drove me to conduct this research, highlighting the necessity and potential of its kind.

1.2 Thesis Rationale

Climate change has adversely impacted coastal areas of continents and islands across the globe (Intergovernmental Panel on Climate Change [IPCC], 2014, p. 330). Coastal areas had already threatened by stress factors such as proliferation of development programmes, higher population growth compared to other areas, rapid urbanisation, industrialisation, overexploitation, loss of species' habitat, and pollution (Coulthard, 2009). As further discussed later in the chapter, these stress factors threaten to continuously damage Sri Lanka's coasts.

1.2.1 Climate-Induced Vulnerabilities and the Coast

The high concentration of greenhouse gases, positive radiative forcing, detected warming, and existing knowledge of climate systems evidently suggest that anthropogenic activities contribute to changes in the coastal climate system. The impacts due to these changes can be observed through phenomena such as warming of the atmosphere and ocean, fluctuations or deviations in the global water cycle, melting of glaciers, rise in global mean sea level, and frequent extreme weather or climate events all over the world. Despite the mitigation measures or any other strategies that have been implemented to

reduce the causes of climate change, the impacts are likely to continue until 2100, due to the damage that has already been done over the years (IPCC, 2014).

Interestingly, these impacts will not be uniformly distributed and the damage they can cause is idiosyncratic to the particular population, place, group, community, and system depending on how resourceful and responsive the people of such regions are to climate change impacts. The effect that these impacts can have on the poor is excessive, due to a lack of means to adapt because of their over-dependence on natural resources for their livelihoods and well-being (Bood, 2009).

Amoani et al. (2012) and Gornitz (2000) suggest the effect of climate change is even more severe in dynamic, multifunctional, and densely populated coastal regions, especially in developing countries, because of their exposure to floods, storm surges, cyclones, and tsunamis. Further, it has been noted that the fragile and complex nature of coastal areas can amplify such impacts, generating more damages to coastal livelihoods (Ireland, 2004). Glavovica and Boonzaier (2007) observed that coastal resources, poor coastal communities, and their livelihoods could be severely affected by global climate change.

Despite the risks, population growth in coastal areas shows an increasing trend. There is evidence to suggest that coastal communities record faster population growth rate compared to that of non-coastal communities (Creel, 2003). It is also estimated that one-fifth of the global population lives within the radius of 30km from the sea (Gommes et al., 1997). World Ocean Review states that more than a billion people, out of which the majority represent Asian communities, live in low lying coastal regions (WOR, 2010). This suggests the number of lives and livelihoods along coastal communities that will be affected by climate change will be enormous.

A study by Nicholls and colleagues for the Philosophical Transactions of the Royal Society (PTRS) further explains that Africa, South, Southeast, and East Asia are the most vulnerable regions to sea level rise in the world. They state, “these regions are the areas where protection is most likely to not occur or fail, and they collectively contain a significant proportion of potential environmental refugees, especially the Asian regions” (Nicholls et al., 2011, p. 175). Furthermore, the Food and Agriculture Organisation of the United Nations (FAO, 2009) estimates that about 456 million people in these regions are

malnourished (Sivakumar & Stefanski, 2011) which poses a further threat, particularly for the population in the coastal countries along the Indian Ocean due to their high vulnerability (Dasgupta et al., 2007). It is also estimated that about one third of the world's population where the majority is from developing countries suffer from micronutrient deficiencies that bring significant health consequences (Harding et al., 2017).

Nerem et al. (2018, p. 1) outline that “coupled with the average climate–change–driven rate of sea level rise over these same 25 y of 2.9 mm/y, simple extrapolation of the quadratic implies global mean sea level could rise 65 ± 12 cm by 2100 compared with 2005, roughly in agreement with the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5) model projections”. Nicholls and Klein (2005) noted that 131 million people will be affected and 2,463,000km² of lands will be inundated as a consequence of a 1–metre rise in sea level. Apart from these direct impacts, climate change induces several other indirect results, such as salinization of surface and groundwater, loss of wetlands, and loss of infrastructure, that disturb natural systems, social systems, economies, and livelihoods (Padma et al., 2009). Climate change can aggravate existing hazards such as flooding and anomalies in temperature and rainfall patterns. In 2010 it was estimated that 20% of South Asian communities did not have proper access to water services while 27% did not have enough food to consume due to impacts related to climate change (World Bank [WB], 2010). Evidentially, all such issues will have an enormous impact on the food, water, and health security of the communities who live in coastal areas (Rabbani et al., 2010).

Though coastal erosion is a common and natural phenomenon, this process is most likely to be intensified by sea level rise (Huang & Xie, 2000). Rabbani et al. (2010) posited that a 30cm rise in sea level can cause 45m of landward retreat in some coastal areas. Moreover, coastal erosion combined with coastal flooding can damage coastal infrastructures such as houses, industrial installations, tourist and cultural sites, sanitation systems, and transportation and communication networks. Significantly, Gornitz, White, and Cushman (1991) reported that the rate of sea level rise on the Asian coasts is generally higher than the global average. Similarly, Cazenave and Cozannet (2014) state that Southeast Asia is highly vulnerable to the adverse effects of sea level rise compared to other regions owing to its high exposure.

It is evident that the rise in sea surface temperatures due to global warming intensifies cyclone activities and generates more devastating storm surges (Bengtsson et al., 2006; Knutson & Tuleya, 2004). These storm surges associated with strong winds will be detrimental and endangering to coastal areas. Landsea et al. (2006) criticize those arguments based on the unreliability of available data, yet Small and Nicholls (2003) provided evidence to suggest that about 2.6 million people had lost their lives over the previous 200 years due to cyclonic events. Additionally, the American Meteorological Society (AMS, 2007) states that the increase in temperature will affect the patterns of tropical cyclones, which will be detrimental to those people living on the coast. In this regard, Dasgupta et al. (2009) suggest it is crucial to have precautions along coastal areas irrespective of the likelihood of occurrence.

The contribution of the fishing industry to food security and economic development is significant (Badjeck et al. 2010). Fishing is one of the most predominant sources of livelihoods among coastal communities supporting the livelihoods of nearly 520 million people and related industries in the world. This sector provides one of the main protein sources for nearly 1.5 billion people and accounted for \$86 billion USD of exports earnings in 2006 (FAO, 2009). Regardless of the sector's significant and valuable contribution to economic and food sectors, fishing communities are generally regarded as poor and is a highly marginalised group. This is due in part to the uncertainties in income, poor health and sanitary facilities, lack of education, and frequent climate and weather stresses. A study conducted by Gaillard et al. (2009) in the Philippines found that fishers do not pay close attention to risks associated with the weather as they are more focused on meeting their families' daily needs. They further reported that such people are likely to be impacted by external stressors due to their fragile and poor livelihoods. Rabbani et al. (2010) document the severe damage that climate change causes in coastal regions due to poverty, lack of knowledge about climate risks, and unplanned urbanisation with high population growth exposing people to many natural disasters.

Some of the major changes in climate change impacts that scientists observed in fisheries sources were reduction in fish productivity and in fish size, diversity, and composition of the catch. This is a direct result of increasing temperatures damaging fish habitats, for example corals (McWilliams et al., 2005). Coral bleaching is prominent in sub-tropical and tropical coastal regions, whose contribution was 90% of the world's fishers

and fish traders (McWilliams et al., 2005; Munday et al., 2008; Pratchett et al., 2008). It is also argued that unsustainable use of coastal and marine resources encompassing marine litter is today's major environmental problem in developing countries (International Union for Conservation of Nature [IUCN], 2001; Folke, 2006; United Nations [UN], 2011; Williams & Nelson Rangel–Buitrago, 2019). Likewise, United Nations Development Programme (UNEP, 2008) claims increasing populations and their competition for limited resources and prevailing poverty can threaten the sustainable use of oceans and coastal areas. The work of Allison et al. (2009) outlines these impacts more precisely. Given all the evidence in the extant literature, it is obvious that climate change and frequent weather–related stressors can aggravate the situation of the people in coastal regions, with respect to their livelihoods and the very environments in which they live. Accordingly, the climate change–related literature pertaining to coastal communities signifies that it is essential for Sri Lanka to consider that the serious matters raised that need deliberation beyond current national policy positions.

1.2.2 Sri Lanka, Its Coast, and Changing Climate

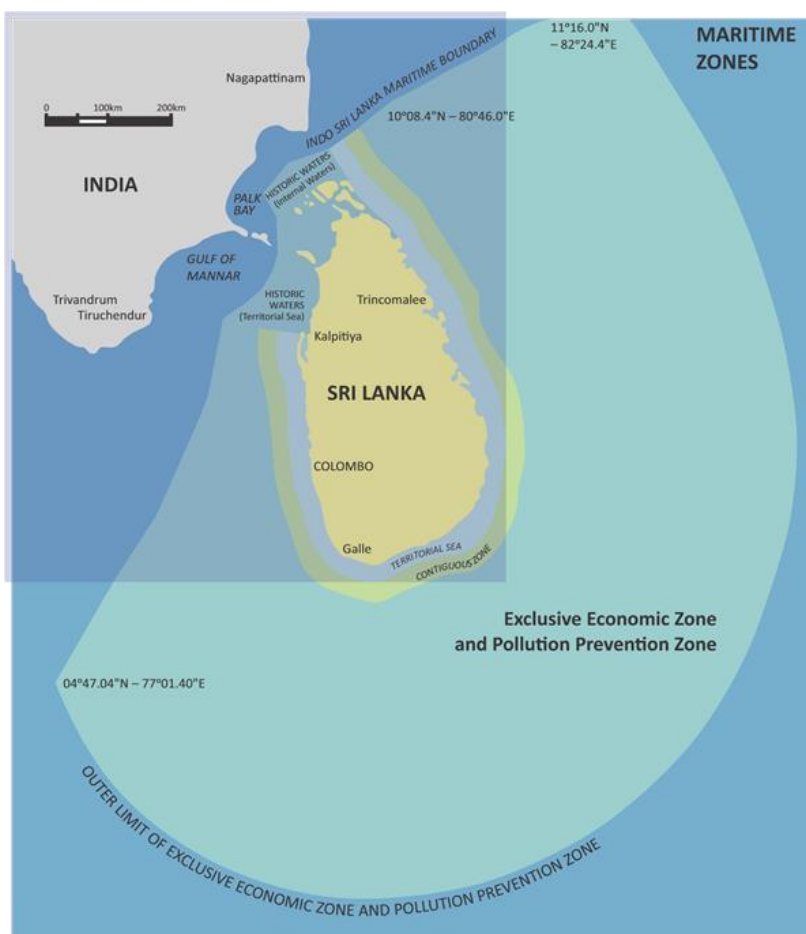
Sri Lanka is an island in the Indian Ocean surrounded by 517,000km² of Exclusive Economic Zone (EEZ), in which Sri Lankans have the sovereign right to utilise and employ all living and non–living resources within coastal waters and seabed in the area (see Figure 1.1). With the relatively small land area of 65,000km² it is estimated the land to ocean ratio for Sri Lanka is 2:15. This positions every Sri Lankan within a 100km radius from the sea. The coastline of Sri Lanka is 2,825km long. The island is a place for many industries and major cities, including Colombo, the commercial capital of Sri Lanka (World Resources Institute [WRI], 2003). According to the Sri Lanka Ministry of Environment and Natural Resources (MENR, 2011a), about 43Gm³ total annual runoff is estimated to be brought about by 103 rivers that spread all around the country. These are responsible for river deltas which are high in biodiversity and provide means of livelihoods to the coastal communities.

The economic and ecological importance of the coastal belt to Sri Lanka is significant. Its coastal area accounts for 24% of the total landmass and 25% of the country's population, about 80% of major industries are located within the region in and around Colombo, and it creates livelihoods for over 2.4 million people. Along the coastline, there are 89 lagoons and 45 major estuaries that are crucial to ecosystem biodiversity and

natural resource–based livelihoods. It is estimated that 86.5% of the total fish production is from the coastal and marine fishery (Ministry of Fisheries and Aquatic Resources [MFAR], 2009) and is central to food security in the country as it provides an affordable source of animal protein to low–income families. Further, 20% of the country’s home gardens and 17% of agricultural lands are also located in its coastal belt. Additionally, the tourism infrastructure that is situated along the coastline accounts for 80% of its total (MENR, 2011b).

Figure 1.1

Map showing Sri Lanka’s maritime boundaries



Note. Source: (Coast Conservation Department [CCD], 2006)

The Coast Conservation Act of 1981 defines the coastal zone as:

The area lying within a limit of 300 m landward of the Mean High Water Line (MHWL) and a limit of 2 km seaward of the Mean Low Water Line (MLWL). In case of rivers, streams, lagoons, or any other body of water connected to the sea either permanently or periodically, the landward boundary extends to a limit of 2 km

measured perpendicular to the straight baseline drawn between the natural entrance points of the relevant waters. (MENR, 2010, p. 38)

This Act was operationalised in 1983 with the change of direction from coastal protection to coastal zone management. Even though the geographical definition of the coastal zone in the coast conservation act is criticised by many for its narrow scope, the broader aspects of its new direction are well regarded (Rabbani et al., 2010). A study conducted by Weerakkody (1997) found that the Sri Lankan coast is very sensitive to the ocean and environmental changes that occurred during the last high-level sea stand, and which could still be seen along the coast. Likewise, Swan (1964, 1966) reports that the origin of the Sri Lankan coast is polygenetic due to changes caused by sea level fluctuations which happened in the 1950s. Global Climate Change Models suggest that Sri Lanka will experience severe climate change impacts due to global warming (Munasinghe, 1998). Sri Lanka is more vulnerable to climate change impacts as it is characterised by relatively low line coastal areas, high population density (Samaranayake, 2003; Wickramasinghe, 2010), and prevailing poverty conditions along the coast (Athulathmudali et al., 2011). Human settlements built in the coastal region are at risk related to natural disasters mainly due to poor urban planning, negligent construction standards and lack of awareness of the real possibility (Silva & Yamao, 2007).

Tropical cyclones are a frequent phenomenon in the countries situated in the Indian Ocean. However, recent studies suggest that not the frequency, but the high intensity of future cyclones could destroy the ecosystems and vulnerable communities along with the coastal belts in South Asia, where Sri Lanka is situated (Rabbani et al., 2010, p. 18). Cyclones are expected to contaminate inland water sources, which could lead to water-borne diseases like diarrhoea and cholera. Studies conducted in 84 developing countries in five major regions to assess the vulnerability of coastal zones to intensifications of storm surge estimated that 55.46% of the Sri Lankan coastal wetlands will be threatened by future storm surges (Dasgupta et al., 2009). Rabbani et al. (2010) further assert that it will be a major threat to countries like Sri Lanka, where saltwater intrusion is already a problem for drinking water sources.

Short-term inundation due to high-intensity rainfall will be a problem in low-lying coastal areas as the most common natural disasters in Sri Lanka include droughts, floods, and landslides. The variety of ecosystems on the Sri Lankan coast includes coral reefs,

coastal wetlands, lagoons, beaches, and sand dunes, all vulnerable to sea level rise either due to inundation or coastal erosion (MENR, 2011b). Most of these ecosystems are currently central feeding and breeding grounds for the marine fishery, thus the damage climate change may cause to the fishing industry is considerable. It threatens to destroy coastal habitats such as coral reefs and mangroves and to change the distribution of species, further damaging ecosystems (MENR, 2011a; Hughes et al., 2017).

Sea level rise can damage the infrastructure built along the belt and also the measures established to protect estuaries and the coast from erosion. This situation is considered worse in countries like Sri Lanka where coasts are characterised by low-lying coastal plains. Sea level rise causing coastal erosion to intensify is one of the biggest problems for beach seining fishery and associated livelihoods in Sri Lanka. Beach seining is a traditional type of fishing that requires a larger coastal area for hauling fishing nets manually. Hauling of fishing nets usually requires 40–100 people in addition to a larger space to dry the nets. In effect, about 12 fishery harbours and fishery landing sites will also be negatively affected due to erosion and projected storm surges (CCD, 2006). Also, anomalous rainfall patterns and increasingly warmer temperatures will further aggravate this situation leaving coastal livelihoods in desolation (MENR, 2010).

The predicted rise in ocean temperatures in the next few decades is likely to cause heat stress to coral-forming marine invertebrates that will hinder the progress of forming corals (MENR, 2010). Rise in temperature together with ocean acidification and the El-Nino effect has the potential to destroy an entire coral reef, leaving some marine and coastal species homeless (Hughes et al., 2017). There is evidence that such damaged areas can be invaded by certain other species that can thrive in those harsh conditions and accelerate the deterioration of the reef. One such example is *Halimeda* sp, a green alga that invaded and caused further degradation to the coral reef in Weligama, which was severely affected by the El Nino (MENR, 2010, p. 47).

Consequently, climate change-induced vulnerabilities add another dimension to the poverty of the vulnerable populations mainly through environmental degradation and weakening of ecosystem-based goods and services upon which their livelihoods rely (Asian Development Bank [ADB], 2009; MENR, 2010). As coastal livelihoods, specifically fisheries, are profoundly reliant on natural resources for productivity, it is vital that development of the fishery sector should take into account the complications of climate

change (MENR, 2011a). According to MENR (2010), climate change impacts will affect alternative livelihoods, food security, access to resources, and the education levels of the fishing communities.

The history of Sri Lankan politics provides several examples of political opportunism and authoritarian politics (Gunasekara, 2020; Jayasuriya, 2019; Miap, 2018). One such example occurred in 2012, when the Government deployed the police to stop a protest organized by unarmed fishers in the study area (Chilaw DS) over a fuel price increase of 50%. The event cost the life of one fisher and three others were wounded. One of these wounded fishers later committed suicide due to depression over losing his leg after having been shot by the police (National Fisheries Solidarity Organisation [NAFSO], 2012; World Socialist Web Site [WSWS], 2012). His family, his widow with four children, were included in my research. Thus, I personally witnessed the devastation it caused to them when they were completely neglected by the authorities after the incident. With this in mind, it can be concluded that the Sri Lankan coast and its livelihoods are additionally substantially vulnerable to the geographical, demographical and socioeconomic factors, and political impacts of climate change (Jayasuriya, 2019; NAFSO, 2012; Pussella et al., 2015; Wickramasingha, 2015).

The coastal livelihoods, particularly those of the fishing community of Puttalam district of the North Western province of Sri Lanka, were found to be the most vulnerable to sea level rise and droughts in the event of climate change according to the vulnerability mapping conducted by the Ministry of Environment of Sri Lanka (Athulathmudali et al., 2011; MENR, 2010). A study was conducted by Pussella et al. (2015) to understand coastal changes and associated vulnerabilities of the North Western Province of Sri Lanka. Puttalam district is one of two districts where the study area is located and is the one bounded by the sea. The results demonstrate that 60% of its coast is vulnerable to natural disasters and climate change impacts. They warn that the situation will be acute if the current state of affairs continues without an intervention either to minimize the impacts of global warming or man-made threats to the coast.

The study, which is primarily guided by Geographical Information Systems (GIS) technology, further concludes that variables of shoreline erosion and accretion, barrier types, land use pattern, and geomorphology have a strong relationship with the physical vulnerability of the coast, thus impacts on such variables would impact the coast in return.

Consequently, they stress the need to respond and adapt to human–induced risks initiated by the process of climate change, especially sea level rise and coastal erosion. Also, they emphasise the significance of realizing the prospects of natural disasters such as floods, storms, and cyclones together with marine and coastal pollution (Pussella et al., 2015). Subsequently, premised upon the available literature and seriousness of climate change, this study examines the possible effects of climate change impacts on the livelihoods of five main coastal villages located in Chilaw DS of Puttalam district of Sri Lanka in addition to existing pressures of poverty, overexploitation, and pollution (ADB, 2002; Chilaw Divisional Secretariat Resource Profile [CDSRP], 2014; MENR, 2010; MENR, 2011c; Samaranayake, 2003).

Despite the degree of threat and the potential further loss climate change could create, its effects on coastal communities and their livelihoods in Sri Lanka have been largely ignored while agriculture and forestry have received more research attention and climate policy discussions. Although adaptation to natural stresses is not a novel concept for coastal communities owing to the rigours of their livelihood, Adger et al. (2003) argue that the new challenges brought by climate change will likely exceed the ability of fishing communities to adapt on the basis of their past experience (Allison et al., 2009). Thus, there is an urgent and critical need for investigation of both the extent of vulnerabilities and feasible adaptation options for those communities who have to face the climatic pressures (Coulthard, 2009).

From a different perspective many scholars argue the significant role of human cognition, which is often referred to as perception, in the process of vulnerability and adaptation (Baron & Petersen, 2015; Grothmann & Patt, 2005; Weber, 1997, 2010). These arguments are based on the difference between perceived risk and actual risk as well as available capacity and applied capacity where both are largely influenced by people's perception (Grothmann & Patt, 2005; Kuruppu & Liverman, 2011; Madhuri et al., 2014; Weber, 2010).

Encompassing perception in climate change literature is often overlooked and Sri Lanka in particular does not hold any record of a previous empirical study on perception and its relationship with vulnerability and adaptation in relation to coastal livelihoods. Thus prevails the gap. All things considered, together with researcher expertise, skills, and available resources, in this thesis I attempt to investigate how the closer knowledge of

perception and livelihood vulnerability of coastal communities assists adaptation to offset the effects of climate change impacts on coastal livelihoods in five fishing villages of Sri Lanka.

1.3 Research Question and Objectives

The main research question founded upon the identified research gap is: How can a better understanding of the perception and livelihood vulnerability of coastal communities assist adaptation to offset the effects of climate change impacts? In order to guide and progress the main research question, four research objectives are established at the outset. They are to:

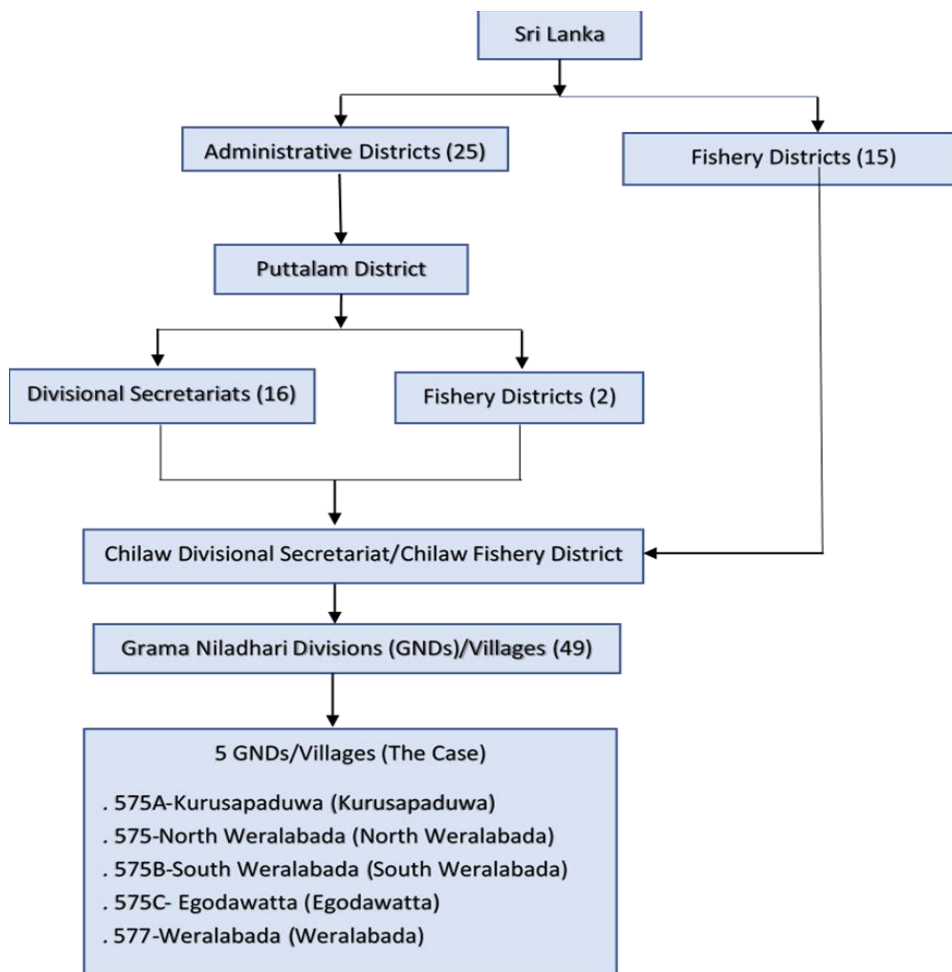
- identify the extent to which coastal livelihoods are vulnerable to weather-related stresses and climate change impacts.
- identify the level and the contextual dimensions and determinants of perception upon which adaptation intentions and actions are constructed.
- examine the ways in which perceptions of communities are translated into behaviours in the event of weather-related stresses and climate change.
- understand the socioeconomic and political milieu in which the phenomena of climate related perceptions and vulnerabilities operate, and respective adaptation measures are developed and established.

1.4 Research Context and Approach

The administrative structure of Sri Lanka is comprised of four main levels. From the highest order to the lowest they are demarcated as provincial level; district level; divisional secretariat level; and *Grama Niladhari* (GN) level (MENR, 2011a). This research is based in five *Grama Niladhari* Divisions (GNDs) which also are referred as villages in Chilaw Divisional Secretariat (Chilaw DS) of Puttalam district of the North Western Province. Owing to its substantial contribution to the fisheries sector, Chilaw DS is termed as one of the 15 fishery districts in fisheries management, although it is not one of the 25 administrative districts in Sri Lanka. It is one of 16 Divisional Secretariats (DSs) and one of two fishery districts that belong to the administrative district of Puttalam (MFAR, 2018). Puttalam district covers an area of 3,072km² and accommodates a population of 777,000, of which only 21.39% have secondary education and 13.1% live in poverty (MENR, 2011a). Figure 1.2 shows the hierarchical position of the selected case starting from district level.

Figure 1.2

Hierarchical position of the case of five coastal villages



Note. Source: Author

Accordingly, Chilaw DS (see Figure 1.3) was purposively selected for this study for four main reasons described as follows. First, it is one of the 16 Divisional Secretariats (DS) in Puttalam district which was assessed as the most vulnerable to sea level rise exposure by the Ministry of Environment in Sri Lanka (MENR, 2011a). The study reveals that five of its main DSs fall within the highly vulnerable category and another five DSs, including Chilaw, fall within the moderate category Chilaw DS is included (MENR, 2011a). Secondly, the Chilaw city is located in the lowest lying coastal plain in Sri Lanka and margined by three main water bodies, the sea; the river named “Deduru” (*Deduru Oya*); and Chilaw lagoon, that are highly important to the livelihoods in the area and also impacted by climate change, weather-related stressors, and humanmade pollution (CDSRP, 2014). Thirdly, it is situated on the north-western coast of the country which is found to be highly vulnerable to erosion (Pussella et al., 2015). Fourthly, the accessibility—one of the crucial factors to

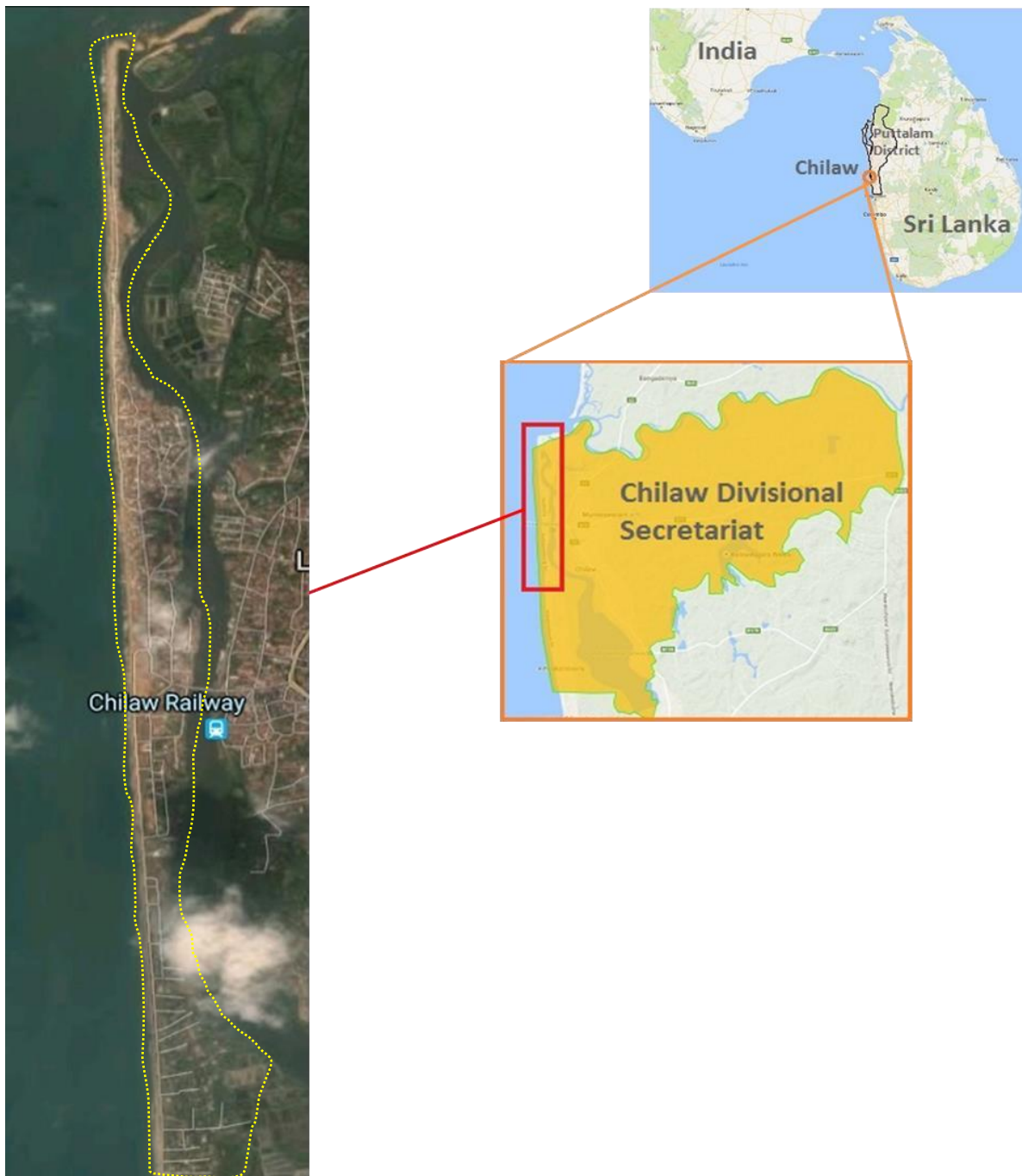
be considered in selecting a case (Stake, 1995)—of the households in Chilaw DS was relatively convenient for me.

Chilaw is a city with a great heritage and situated approximately one and half hours' drive from Colombo, the commercial capital of Sri Lanka (Joseph, 2011). The total land area of Chilaw DS is estimated at 178km², and it marks the north–western border of Sri Lanka located at 7^o 35' north latitude and 79^o 47' east longitude and 9.3 metres above sea level. The city is margined by *Deduru Oya* from the north and the sea from the west. The population of Chilaw DS was 69,887 in 2014 with the majority belonging to the age group of 31–59. The male and female percentage is recorded as 47.6% and 52.4% respectively. The agriculture, fisheries, trade, industry, government, and corporate sectors are the main sources of employment of Chilaw DS (CDSRP, 2014). The poverty rate of the population of Chilaw DS is 20.11%, whereas 21.74% have completed secondary education (Government of Sri Lanka [GOSL], 2013). The land size of Chilaw villages (GNDs) varies between the largest at 6.2km² to the smallest at 0.1km² (CDSRP, 2014; Joseph, 2011).

Chilaw DS is located in the Intermediate Zone in between the country's other two climatic zones termed as Wet and Dry (ADB, 2002). It experiences heavy rains from south–west monsoons from May to September and inter–monsoon rains accompanied with thunderstorms and cyclones in the months of April and November with a mean annual rainfall approximately of 1500mm (ADB, 2002; Joseph, 2011). The two main water sources of Chilaw DS are the 88–mile long *Deduru Oya* and the Chilaw lagoon which covers an area of 6.5km².

Figure 1.3

The location of Chilaw DS and its 49 GNDs and strip of five selected GNDs.



Note. Source: (Google, 2022). Additional labels edited by author.

The in-depth interviews and FGDs reveal that sea fishers in all five GNDs follow similar practices of their personal choice despite their different locations. In other words, the differences in fishing are attributed to their preferred methods, independent of the location. When it comes to sea fishery, almost all fishers use satellite technology, motorised boats, and equipment used for fishing on the far shore. A complete journey

consumes 7–8 hours of their time, and this time doubles if they take two trips. However, when it comes to multiday boats, the time differs as most fishers usually stay in the sea for nearly two weeks or more. In this case the operation requires the assistance of a larger group of fishers—around 15–25, whereas the day trips are usually conducted with 4–5 fishers. The two main fishing seasons of the villages are known as “Waarakan” (usually May to October) and “Walaala” (usually November to April) where the former yields a better harvest. Most households practice fish drying in open air, thus the process is affected by temperature, humidity, and rainfall. Due to the limited space they have, some households dry the fish on their house roofs while others carry out drying along the road. Most households consume part of the fish catch, while the excess is often sold during the Chilaw fair which is located within walking distance. However, a few households in the area conduct fish sales at the fair as a larger scale business. Dried fish curry (known as “karola”) is also a delicacy in Sri Lankan cuisine.

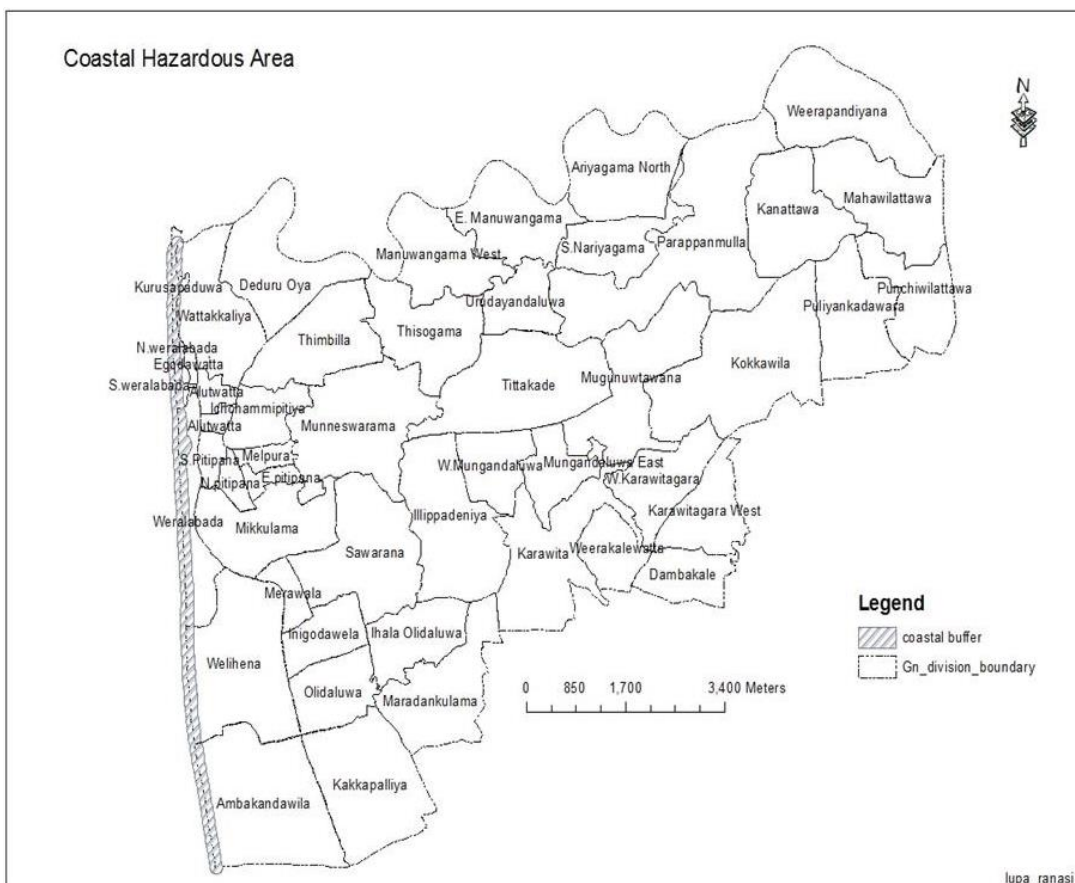
In Chilaw DS, the most common natural disaster of the area is flooding, mainly owing to overflow of the lagoon (Joseph, 2011; Priyadarshana et al., 2016). However, during the 12-year period from 2002 to 2014, the area reported six main natural disaster situations. This encompasses: a tsunami in 2004; floods in 2006, 2010 and 2012; two tornados in 2009; and a drought in 2011. The 2004 tsunami did not cost lives of fishers in the area, but their assets). Later, in 2015, I personally experienced the floods during the time of data collection and the same area was hit by floods again in 2018 (Anon, 2018). The area records a fairly warm temperature throughout the year; the mean annual temperature is noted as 27°C. Chilaw DS is the home for 18,390 households and consists of 49 GNDs (CDSRP, 2014), out of which five were selected as the case for this study, *Kurusapaduwa; North Weralabada; South Weralabada, Egodawatta; and Weralabada.*

The selection of these five coastal GNDs in Chilaw DS as the case was based primarily on three criteria. First, the geographical locations of all GNDs in relation to the lagoon and the sea are similar (Figure 1.3). All five GNDs are located in the narrow land strip, considered a sand dune, formed between the coast and the lagoon of Chilaw DS (Joseph, 2011). Second, the size of the land area of GNDs and their population densities are similar. Four of the selected GNDs were the smallest in size of their land area (CDSRP, 2014). The size of three GNDs was estimated at 0.1 km² while the other was estimated at 0.2km². In fact, three of those GNDs recorded the highest population density of all 49 GNDs in Chilaw

DS. In order of population density, *South (S) Weralabada* (5,210 persons per km²); *North (N) Weralabada* (2,580 persons per km²); *Egodawatta* (2,350 persons per km²). The fourth GND, *Kurusapaduwa*, is 0.2 km² in size and situated at the inlet (*Moya Kata*) whereas the fifth GND, *Weralabada*, margins the other end of the study area which was situated in the narrow strip of the land between the lagoon and the sea. Finally, all selected GNDs, except for *Egodawatta*, are located in the coastal hazardous area (see Figure 1.4) according to the data provided by AGA of Chilaw DS, thus the risk of exposure is greater making them more ideal for this research (CDSRP, 2014). Although technically *Egodawatta* is not part of the coastal hazardous area, it is in the vicinity and prone to risk.

Figure 1.4

Coastal hazardous area of Chilaw DS



Note. (Source: CDSRP, 2014)

In all, the villages represent relatively homogenous coastal settings. They are homogeneous in the sense that they have similar geographic and demographic profiles. All selected five GNDs recorded fishing as the main livelihood. Also, all five have similar ethnic and religious backgrounds where in each GND 98–100% are Sinhalese and Catholics

(CDSRP, 2014). As previously mentioned, they are all situated in the narrow land strip formed between the sea and the Chilaw lagoon, the two main environmental settings that determine their way of living (CDSRP, 2014). The majority of the fishers are mainly involved in offshore fishing (Joseph, 2011). Despite the comparatively small number of fishers at present, the lagoon provides a place to unload fish and harbour the majority of the 17–23ft long Fibre Reinforced Plastic (FRP) boats and 3.5 tonne boats of fishers, one of its two main services, among many others (ADB, 2002).

In addition to the sea, the Chilaw lagoon, which technically is an estuary, plays a crucial role in the daily lives of communities both in terms of food production and livelihoods (Samaranayake, 2003). Its length and width (of the broadest end) are estimated approximately as 29.5km and 2km respectively. It covers an area of 1800ha while the depth ranges from 0.9 to 3m (Central Environment Authority [CEA], 1994) depending on the tidal movements and the rainfall it receives in the catchment area (Jayawickrema & Sideek, 1986). However, the influence of the tidal movements is considered much smaller than that of rainfall. Another attribute of the lagoon is its widespread mud flats which can be seen when the water levels are low (Joseph, 2011). There are two rivers, namely Lunu Oya and Deduru Oya, that bring fresh water into the lagoon with the latter having an open connection to the sea. The lagoon also opens out to the sea, so the water flow from Deduru Oya to the lagoon is comparatively small. More importantly, this opening of the lagoon to the sea is partially blocked by sand bars during the dry season (January–March and June–August) which disturbs the navigation of fishing boats (ADB, 2002; Priyadarshana et al., 2016). This blockage causes many accidents and has also cost many lives of fishers who try to cross the sand bars on their way back. This was found to be one of the major concerns of fishers during the study rather than climate-related distresses.

Brackish water marshes and mangrove forests are common features of the lagoon. These are largely disturbed by unregulated prawn farming during and by various other engagements such as clearing them for coconut plantations, fodder, firewood, fishing gear, and homesteads (ADB, 2002; Joseph, 2011). The selective preferences for some plant species, especially for fishing gear, threatens the existence of the particular species, influencing the biodiversity of the lagoon (ADB, 2002). The major threat of losing feeding and breeding habitats for some fishing species is of concern (ADB, 2002; Joseph, 2011).

The impacts of climate change are not yet evidently realised through reliable scientific data for this particular lagoon, but apparently, they are becoming apparent through anomalies in climate-related events. The lagoon is also largely threatened by pollution. The extensive dumping of domestic waste and sewage, decomposed fish thrown from the adjacent fish market, discharges full of nutrients and chemicals of prawn farms, and runoff fertilisers and pesticides are identified as the main sources of pollution (ADB, 2002; Priyadarshana et al., 2016). The kerosene discharged from harboured boats was also revealed to be a major pollutant during the discussions. This affects the salinity level of the water, hence the fish production. Records on the vegetation of the lagoon revealed the existence of approximately 150 plant species out of which two are threatened (ADB, 2002). A positive perspective on the situation of the lagoon exists. The model test carried out to understand the flood absorption capacity of the lagoon by Priyadarshana et al. (2016) concludes that a storm event that brings around one million cubic meters of freshwater into the lagoon with two-year return period can effectively flush out the lagoon and its outlets. This could be beneficial in managing the floods of the area.

All these particulars of the lagoon demarcate the strong connections or influences that it has on the surrounding GNDs, out of which five were selected. However, all five GNDs were considered as five different cases during the process of sampling owing to these factors and to the intention to find specific socioeconomic factors that are associated with climate-related vulnerabilities unique to each GND, if any are present. The findings were presented for each GND, as well as for all five GNDs considered as one collective unit, particularly in determining the levels and dimensions of perception towards climate-related stresses. This decision was justified on pragmatic grounds. In essence, it is the first ever study that assesses the perception of coastal communities towards climate change-related stresses in Sri Lanka. Thus, the overall view of these five GNDs, which are fairly homogenous, can provide a strong case about perceptions of climate change impacts in similar settings.

1.4.1 Methodological Review

The data collection and analysis of the study are founded upon the research philosophy of pragmatism that permits the use of both quantitative and qualitative techniques. This approach is also demanded by the research objectives. Accordingly, two main surveys were conducted to identify the degree of livelihood vulnerability and the scale of

perception. These are the Livelihood Vulnerability (LV) survey and the Knowledge, Attitude, and Practice (KAP) survey, each with the same 206 participants. The surveys allow the achievement of the first and second objectives of the study. To set the background of the research and to develop the context specific questionnaire, 20 Key Informant Interviews (KIIs) and five Focus Group Discussions (FGDs) were conducted. They also provided qualitative data on all four objectives. The third and fourth research objectives were primarily assisted by 47 in-depth interviews with the selected participants who took part in the surveys. Unobtrusive measures were also adopted as part of the data collection. A pilot survey was conducted prior to the main surveys and the overall data collection procedure was supported by five Research Assistants (RAs), one for each village. The analysis is assisted by the tools of SPSS and NVivo. The findings from this case could also assist the coastal communities experiencing comparable threats in a similar situation across the country and beyond. The data collection procedures were in response to the underpinning of the research which is founded upon several fundamental theories related to livelihood vulnerability, perception, and adaptation. They are discussed in the following section.

1.5 Theoretical Considerations

As the title shows, the study examines five fundamental phenomena, livelihood; vulnerability; perception; adaptation; and climate change. From one perspective, “livelihood vulnerability to climate change impacts,” constitutes the problem while “perception and adaptation,” can be considered as part of the solution. From another perspective, all fundamentals together can be considered as part of both the problem and the solution. Thus the investigation could reveal what part of each fundamental generates the problem and what part of it could be used as a solution. With both perspectives in mind, I attempt to understand and define those fundamentals within the scope of the research and follow the literature that aids the ability to understand relationships between them. In that, the understanding of the multifaceted phenomenon of vulnerability is crucial.

Vulnerability science is one such approach that facilitates the understanding of those circumstances which put people and places at risk and of the factors that impede the ability of those groups to respond (Cutter, 2003). It either integrates or parallels several constructs, such as risk, exposure, hazard, susceptibility, resilience, adaptation, and

sustainability (Cutter, 2003; Kates et al., 2012). Adger (2006) proposes a complementary approach to address community vulnerabilities through three main avenues: addressing perception of risk; measuring vulnerabilities; and attending to governance. O'Brien et al. (2004) establish two very different interpretations of the term vulnerability in climate change literature, namely "starting point interpretation," and "end point interpretation," based on the initial claims made by Kelly and Adger (2000, pp. 326–327). They argue for three main approaches to vulnerability assessments based on the interest of analysts: vulnerability as the end point; vulnerability as the focal point; and vulnerability as the starting point of any appraisal. These are discussed in detail in the Literature Review, Chapter Two.

While both interpretations are vital to address vulnerabilities to the impacts of climate change, this research regards vulnerability as a starting point owing to its applicability in a political economy approach, the foundation of the conceptual framework of this study. According to Fussel (2007, p. 160), such an approach largely resembles the anthropocentric approach of Kasperson, Kasperson, Turner II, Dow, and Meyer (1995).

The political economy approach is capable of delivering results based on my focus which resides in the answers to two basic questions, "who is most vulnerable?" and "why are they vulnerable?" Besides, it facilitates mobilising several concepts and theories to better understand the problem being investigated. Accordingly, this research discusses both subjective (psychological) and objective (physical) aspects of livelihood vulnerabilities in the process of adaptation. Table 1.1 demonstrates the definitions we adopted under each fundamental phenomenon addressed in the study which will be detailed in Chapter Two.

Table 1.1*Definitions of key concepts employed during the study*

Key Concept	Definition
Climate Change	Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (IPCC, 2014, p. 1450).
Livelihood	A livelihood comprises the capabilities, assets (stores, resources, claims, and access), and activities required for a means of living (Chambers & Conway, 1992, p. 6).
Sustainable Livelihood	A livelihood that can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future while not undermining the natural resources base (Chambers & Conway, 1992, p. 9).
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001, p. 995).
Exposure	The nature and degree to which a system is exposed to significant climatic variations (IPCC, 2001, p. 987).
Sensitivity	Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise (IPCC, 2001, p. 993).

Adaptive Capacity	The whole of capabilities, resources, and institutions of a country or region to implement effective adaptation measures (IPCC, 2007, p. 809).
Adaptation	Any type of initiative and measure that contributes to moderate the vulnerability of coastal communities and their livelihoods to both direct and indirect effects of weather related stresses, climate change impacts, and stresses that put their livelihoods and wellbeing at stake (Brooks, 2003; IPCC, 2007; Smit & Wandel, 2006).
Perception	The phenomenon of perception primarily explores people's understanding, awareness, attitudes, and policy preferences towards a particular hazard or a threat (Leiserowitz, 2007; Whitmarsh, 2008). Perception here also refers to the concepts of attitude, knowledge, understanding, and awareness (Bahamonde–Birke et al., 2015).
Political Economy	The processes by which ideas, power, and resources are conceptualised, negotiated, and implemented by different groups at different scales (Tanner & Allouche, 2011, pp. 1–2).

1.6 Importance and Novelty of the Research

The study contributes to the practical realm by providing pragmatic tools to identify the degree of livelihood vulnerability and the forms of perception of climate change-related scenarios that could inform interventions, including policies. It enhances the theoretical realm, by adding knowledge to livelihood vulnerability assessments as well as to the process of adaptation through incorporation of both objective (physical) and subjective (psychological) attributes, in particular the phenomenon of perception.

This is the first in-depth and systematic empirical study employed in a Sri Lankan context to analyse the role of perception in coastal communities upon which their livelihood vulnerabilities are determined, and adaptive mechanisms are built in relation to climate change impacts. For that reason, the findings can help to improve the prevailing integrated coastal management plans and adaptation measures for better outcomes. Tools developed as part of the research, including the Livelihood Vulnerability Index (LVI) and Perception Index (PI), can assist stakeholders on all sides of the issue to understand the problem and arrive at more sensible solutions with the available limited resources. Eriksen and Kelly (2007) claim the significance of an index as a reference point that can be used in development policy related evaluations while Preston et al., (2011) state its significance in comparisons and usability in prioritising resources. This study could make these contributions.

From a methodological perspective, combining both perception and livelihood vulnerability in terms of indices to understand the holistic view offers an alternate and novel way of measuring climate change impacts on livelihoods at the community level. Besides, the findings envisage pioneering a public dialogue about the subject of climate change that is still proven to be an abstract and distant concept for the coastal community of Chilaw DS despite its repercussions that they endure at present.

1.7 Organization of Chapters

This thesis consists of seven chapters. Following this introductory chapter, Chapter Two, the literature review, investigates the contemporary arguments on livelihood vulnerability and associated concepts. Thus, it identifies and defines the key terms to assist the research objectives within the scope of the study and finally arrives at a conceptual framework. Chapter Three details the methodology of the study encompassing

research approach, design, dimensions, strategy, population and sampling techniques, data collection methods and associated limitations, and the ways that validity, reliability, and ethical considerations are addressed. It provides a detailed description of and justification for using mixed methods in the research. Chapters Four, Five, and Six of this thesis present the results, while Chapter Seven is the discussion and conclusion.

The results from the descriptive analysis and participants' demography are presented in Chapter Four to provide a comprehensive view of the context within which the research took place while Chapter Five addresses the first objective of the research: identify the extent to which coastal livelihoods are vulnerable to the climate change impacts, weather, and nature related distresses. While appreciating an index approach in livelihood vulnerability assessments, it elaborates the way the Livelihood Vulnerability Index (LVI) is constructed and computed. It then presents the relative sector vulnerability scores under eight main components (or sectors) in relation to five main coastal villages together with the results of overall LVI and LVI-IPCC.

Chapter Six discusses the findings relevant to the second objective of the research: to identify the level and the contextual dimensions and determinants of perception upon which their adaptation intentions and acts are constructed. It constitutes the construction of scales of perception and results in five perception indexes that cover the major dimensions of attitude and awareness, understanding of the causes, familiarity and experience with the impacts, sensitivity to the impacts, and adaptability of the community.

Chapter Seven of the thesis discusses the results of Chapters Four, Five, and Six together with their qualitative aspects while addressing the third and fourth objectives of the research: to analyse the ways in which community members perceptions are translated into behaviours, and the socioeconomic and political milieu in which the fundamentals of perception, vulnerability, and adaptation are operative. Thus, it characterises the adaptation and triangulates the findings which are presented in Chapters Four, Five, and Six.

Chapter 2. Literature Review

2.1 Introduction

The concepts of livelihood, hazard, risk, disaster, and vulnerability are crucial to understanding and responding to the impacts created by climate variability and change. Vulnerability Assessments (VAs) in particular play a critical role in assessing climate change impacts by facilitating the creation of ways and means either to overcome or exploit them. They are often conducted to understand two equally important arenas of vulnerability—biophysical vulnerability and social vulnerability (Zahran et al., 2008). The former has already attracted the attention of both the research community and policy makers of Sri Lanka, leading to a considerable number of publications (e.g., ADB, 2002; Baba, 2010; MENR, 2011a, 2011b, 2011c; MENR, 2010; Weerakkody, 1997; Wickramasinghe, 2015). However, social vulnerability has often been neglected. The latter is repeatedly misunderstood as merely a list of issues faced by the system of concern despite its significance in terms of contributing factors and underlying causes. According to Giddens (2009), “proper and detailed vulnerability assessments should be the first line of defence in adaptation, since practical action is hardly feasible if the extent and locations of risks are not known” (p. 178). From his perspective, the ultimate objective of vulnerability assessments is to enhance adaptation.

Although mitigation and adaptation are considered equally important in addressing climate change impacts, a focus on adaptation is more prominent in the context of marginalised communities. First, adaptation can be seen as a measure to avoid the impacts brought by the changes in climate which have already taken place despite mitigation measures. In fact, Elum et al. (2017, p. 247) claim that adaptation is the only approach that can address current and impending impacts of already changed climate on vulnerable populations. Secondly, it can bring immediate benefits to affected communities, unlike mitigation. Thirdly, it can be practised on a small scale; thus, its efficacy is independent of the contribution of the international community. Fourthly, adaptations to climate change also minimise the risks brought by contemporary climate variabilities such as the occurrence of extremes (Adger, 1999; Fussel & Klein, 2006; IPCC, 2014). However, adaptation is largely determined by adaptive capacity (Laitonjam et al., 2018) which is manifested by the natural, human, social, physical, and financial livelihood capitals, according to the Sustainable Livelihoods Approach (SLA). This provides the

foundation for adaptation (Simane et al., 2016). Premised on the argument of McLeod (2001), I used the term socio-political capital instead of social capital, because as he argued resource entitlements are largely determined by a country's politics—which may include political demagoguery—and governance. Kasperson and Kasperson (1996) also highlight how politicians may articulate risk in a way that is intended to influence public priorities to suit hidden political agendas.

On the other hand, human cognition, particularly perception, may act either as a barrier to or driver of adaptation (Button, 2013). In other words, whether a policy or a certain act is supported or opposed is largely determined by the way members of the public perceive the subject that the policy addresses (Leiserowitz, 2006). From a different yet complementary perspective, Nursey–Bray et al. (2012) claim that the significance of perception in influencing social aspects of VAs is not widely recognised. Scholars argue that the knowledge of vulnerability, and associated phenomena like resilience, adaptation, sustainability, and risk perception provides the basis for robust vulnerability analysis (Naude et al., 2009; O'Brien, Quinlan, & Ziervogel, 2009; Prowse, 2003).

The complexity of the relationships between vulnerability and adaptation are given due recognition in this research. The significance of understanding the extent of livelihood vulnerability with its subjective (psychological) and objective (physical) aspects in order to offset the impacts of climate change on coastal villages of Sri Lanka has never been recognised. Therefore, this is the main focus of this study. The study also examines the adaptations that are currently in place to understand how far they are aligned with sustainability. Accordingly, this chapter identifies theoretical perspectives on the concept of vulnerability and its affiliated phenomena, to arrive at a conceptual approach that achieves the research objectives. Further, the uncertainties associated with the phenomenon of climate change are acknowledged and stated in the study.

The remainder of this chapter discusses:

- climate change and uncertainty
- the concept of livelihood; notion of hazard, risk, and disaster
- vulnerability, including its definition, prevalent approaches, and the rationale for the approach used in the study
- four concepts associated with vulnerability namely perception, resilience, adaptation, and sustainability
- vulnerability assessments
- the scale of perception and the ways in which it is conceptualised
- the conceptual framework of the study

2.2 Climate Change and Uncertainty

Climate change impacts on coastal ecological systems can create social dilemmas, including human conflict (Barnett & Adger, 2007). Therefore, climate change has significant institutional and political implications. However, identification of these implications is constrained by prevailing uncertainties about climate change and need for further research within the field itself, particularly since global analysis of climate change cannot be always generalised to certain regions and smaller units such as villages (Dessai & Hulme, 2007; IPCC, 2007; Orenco & Fujii, 2013). Compared to physical vulnerability, social vulnerability is more difficult to analyse since it is temporally and spatially variable and dynamic (Cutter & Emrich, 2006). In addition, local environmental changes resulting from land use planning—including both those that mitigate climate change and those that cause harmful environmental impacts (Rahman, 2014)—together with the aforementioned uncertainties and low adaptive capacities, further exacerbate the uneven impacts of climate change on densely populated coastal communities (IPCC, 2007; Smit & Wandel, 2006). Furthermore, as the IPCC (2007) acknowledges, it is difficult to determine the precise impacts of climate change on humans and their natural environments because of the effects of adaptation and non-climatic drivers. Equally, it is hard to differentiate adaptation actions that solely address the impacts of climate change and do not affect communities in other respects (Kates, 2000; Kelly & Adger, 2000). Therefore, policy makers and relevant stakeholders need to address climate change in the context of uncertainty.

Cutter (2003) describes the “Precautionary Principle” (PP) or as others term it, the “Precautionary Approach” (PA), as one way to deal with those uncertainties. The precautionary principle is embedded many international treaties and used by many nation states (Wang, 2011). The United Nations (1992) defines the Precautionary Approach in Principle 15 of the Rio Declaration on Environment and Development:

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. (UN, 1992, p. 5)

The precautionary principle creates a space in which to make rational decisions that counter political demagoguery. In fact, it is logical to assume that a developing country like Sri Lanka where political demagoguery is evident (Gunasekara, 2020; Jayasuriya, 2019; Miap, 2018; NAFSO, 2012) is indeed in need of such an approach. The use of the precautionary principle can be a safeguard for economically and politically marginalised people (Chambers, 1989) whose livelihoods are further threatened by climate impacts in vulnerable coastal communities. Although the 2003 National Environment Policy (NEP) of Sri Lanka articulates the importance of sustainable development and endorses the precautionary principle in dealing with environmental matters (Hewawasam & Matsui, 2019; MENR, 2003), it has not been applied to an obvious extent. This emphasises the need for all levels of government in Sri Lanka to implement what is stated in the country’s legislation and regulatory framework.

2.3 The Concept of Livelihood

The concept of “livelihood” emerged in the late 1980s, providing a broader and more detailed description of how people make a living than concept of “employment”. The term livelihood refers to the way people see and understand their needs for survival. Chambers and Conway (1992) define livelihoods as “the capabilities, assets (stores, resources, claims and access) and activities required for a means of living” (p. 6)—a definition also adopted by the Department for International Development (DFID) (1999) in its report introducing the Sustainable Livelihoods Approach. For these reasons, the concept of livelihood is often used to understand communities’ vulnerability to the impacts of climate change (Badjeck

et al., 2010; Momtaz & Asaduzzaman, 2018). Additionally, vulnerability is a core concept in the livelihood and poverty literature (Chambers & Conway, 1992; Adger, 2006). Thus, there exists a strong association between these two concepts. Moret (2014), who conducted a literature review on vulnerability assessment (VA) methodologies, identifies the importance of incorporating a livelihood perspective in VAs to examine multiple stressors of vulnerability.

According to Carney (2002), diversity is an important aspect of the concept of livelihood. It refers to the number of activities and strategies undertaken by different members of the same household to sustain their lives and improve their wellbeing (Ellis, 2000a). These dynamic and diverse facets of the concept of livelihood make it more complex than “employment” (Chambers, 1995; Scoones, 1998, 2009). The livelihood strategies of the poor are usually complex and diverse. They typically require the labour of all family members for the majority of the time, or at least at certain times during the year (Agarwal, 1989; Chambers, 1991).

The lives and livelihoods of the coastal poor are set within a wide variety of environmental, social, economic, and political dimensions that are very dynamic in nature (Ireland, 2004). The dynamism and competition around utilizing limited resources are detrimental to the coastal poor because their capacity to compete and adapt is very limited. Sadly, these circumstances are further exacerbated by the impacts of climate change (Daw et al., 2009). Such a combination of impacts which O’Brien and Leichenko (2000, p. 227) call “double exposure” is clearly articulated in their research examining simultaneous impacts of globalisation and climate change on social and ecological systems.

The impacts of globalisation (e.g. free trade agreements) together with climate change effects, can create new sets of winners and losers (O’Brien & Leichenko, 2000; Leichenko & O’Brien, 2008). In fact, globalisation can either exacerbate the consequences of climate change or offset its impacts, thus playing a crucial role. Africa, for example, is negatively impacted by both its relatively small contribution to the global economy and its high degree of vulnerability to climate change impacts (O’Brien & Leichenko, 2000, p. 228). The increased use of fertilisers and pesticides as a result of the globalisation of industrial agriculture threaten the very existence of native drought-resistant varieties of crops.

Bradshaw (2014, pp. 149–181) describes how climate change and globalisation interact, with implications for energy security.

However, according to Adger (2006), people’s livelihoods are vulnerable to shocks if people do not have adequate real income and wealth, and if they have few possessions and resources. He argues that the Asian tsunami of 2004 showed how natural disasters expose the underlying vulnerabilities of social and ecological systems (Adger, 2006). Many scholars argue that risks and hazards provide a framework for decision makers to develop policies that take the wellbeing of social and ecological systems into consideration by addressing their vulnerabilities (Adger, 2006; Adger et al., 2005). Complementary to these arguments is the IPCC definition of vulnerability (see page 35) which views vulnerability to climate change as a function of exposure, sensitivity, and adaptive capacity to accommodate the notion of risk, impacts, and ability to adapt (O’Brien et al., 2004). This is also in line with Prowse’s argument (2003) that the literature on hazard has significantly influenced vulnerability literature.

2.4 Notion of Hazard, Risk, and Disaster

Concisely, a hazard is a threat that has a potential to damage people, places, or systems (National Research Council [NRC], 2010). From the perspective of climate change as a stressor, hazards can be divided into two groups: sudden onset and chronic hazards. The difference between the two is significant in terms of perception and policy. Onset hazards like floods are sudden and predictable whereas chronic hazards such as sea level rise and prolonged droughts are slow and hard to predict unless they reach a certain tipping point when the outcomes are very often devastating.

Hazards have many traits and attributes which are used to distinguish one type of hazard from another (Fussel, 2007, p. 164):

- temporal (discrete event or continuous)
- spatial scope (regional or global)
- dynamism (stationary or not)
- degree of certainty (low or high)
- attribution (natural or anthropogenic)
- system of concern (social system or built infrastructure)
- system view (static or dynamic)

- target for risk reduction (exposure or magnitude)
- analytical function (normative or positive)

Despite these differences, many hazards can be destructive depending on the vulnerability of the place, people, and system that experience their impact (Cutter et al., 2009).

Consequently, the combination of hazard and vulnerability is regarded by a number of scholars as being critical (e.g., Blaikie et al., 1994; Wisner et al., 2004), particularly those writing in the natural hazard literature (Etkin & Ho, 2007). Fellmann (2012) argues that the extent of impact is largely determined by the shock itself and the system that is exposed to it. The consequences of the shock are therefore governed by the system's vulnerability and resilience (Fellmann, 2012; Perera, 2012). Conversely, Moret (2014) defines vulnerability as the function of risk and response. Although he does not clearly define risk in this formula, it can be inferred from his reference to the Household Economy Approach of Holzmann et al., (2008) who formulate vulnerability as "baseline + hazard + response = vulnerability" (as cited in Moret, 2014, p. 8). Fussel (2007, p. 160) speaks of "outcome risk" primarily based on the definitions of Adams (1995) and UN (2004) where risk was defined as expected loss due to a hazard.

Regardless of the various definitions, combinations, and relationships with vulnerability, Cutter (1996) states that risk has two domains: potential source (e.g., industrial or flooding) and its contextual nature (e.g., high consequence or low consequence). Adams (1995) and Finucane (2009) argue that risk is socially constructed. From a different perspective, Nelson et al. (2010) emphasise the importance of vulnerability science in understanding spatial and temporal transference of risk, while criticising existing public policies that tend to transfer risk from present to future generations, such as where there is no clear long term vision for high-level nuclear waste management.

Overall, the literature suggests that "risk" is a broad concept that has several interpretations (e.g., Adams, 1995; Cardona, 2003; Kasperson & Kasperson, 1996; Kelman, 2003), yet "in many ways define(s) and constitute(s) the landscape of decision-making for social-ecological systems" (Adger, 2006, p. 2). In addition, risk is intricately linked with the

concept of vulnerability (Fuller & Pincetl, 2015). In this study which focuses on vulnerability, risk is referred to in two ways: one is the dictionary meaning of risk which is often interpreted as a condition that is associated with a harm or danger, and the other is people's perceptions of risk. Risk perception is discussed in Chapter Six of the thesis.

Dictionary definitions of "disaster" tend to describe it just as an event, without explicating its profound connection with the context in which it occurs. However, scholars tend to rely on more comprehensive meanings depending on their subject of interest. Sundnes and Birnbaum (2003) term it as "disruption of the functioning of a society due to widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected society to cope using its own resources" (pp. 144–161) (see Mayner & Arbon, 2015, for more definitions of disaster). This aligns with Cutter et al. (2009) who view disaster as a major catastrophic event that people, places, or systems cannot face or from which they cannot easily recover because of inadequate local capacity. Accordingly, several scholars propose various elements that turn an event like a coastal storm into a disaster. Some of these are: corruption; poor governance; inequitable access to resources; and absence of proper infrastructure and social facilities (Adger, 1999; Sen, 1981). In addition, Cutter (2003) points out that risk, hazard, and disaster reduction policies are largely influenced by vulnerability science, thus they are important in vulnerability studies. In broad agreement with Cutter's claim, Adger (2006) affirms the power of the concept of vulnerability as an analytical tool to guide investigations on marginal systems that are at risk. Therefore, VA is a central part of risk assessment (Momtaz & Asaduzzaman, 2018) where its conceptual frameworks are comprised of parameters that address vulnerability, risk, and coping mechanisms (Moret, 2014).

2.5 Vulnerability

In its simplest form, vulnerability is a relative measure (Downing et al., 2001; Eakin & Luers, 2006) that broadly assesses the potential risk that phenomena such as climate change could impose on rural communities (Nelson et al., 2010; Cutter, 1996). However, scientists with different perspectives and from different disciplines define and explain vulnerability according to their own theoretical framework depending on what they intend to explore (Adger, 2006). Vulnerability is a multifaceted phenomenon, as evidenced by its applicability in numerous different fields (Klein & Nicholls, 1999) which is intricate and complicated (Eakin & Luers, 2006; Fellmann, 2012; Nelson et al., 2010). Some scholars

view vulnerability as a construct that can be assessed approximately with the help of indicators or manifest variables (Adger & Kelly, 1999; Eakin & Luers, 2006; Ionescu et al., 2009). It is also argued that vulnerability can be used as a starting point or end point with specific reference to climate change impacts (Kelly & Adger, 2000; O'Brien et al., 2004). In relation to food security, it is regarded as the focal point (Adger, 2000b). Significantly, Cutter (2003) claims vulnerability can be used in policy. This resonates with policy makers, environmental scientists, and climatologists. It integrates and parallels several other areas of scholarship—such as hazard, risk, sustainability, resilience, and adaptation—to inform risk reduction policies, particularly in local contexts (Cutter, 2003). In essence, some scholars argue, theories of vulnerability stem from the notions of resource entitlement (failures) and hazard philosophies (Adger, 2006; Twigg, 2007; Sen 1981), even though it is now applied in a number of fields including medicine and criminology.

Reducing this complexity to an extent, Nelson et al. (2010, p. 11) suggest that the definition of vulnerability is different from its conceptual framework, and that the two should not be conflated in vulnerability research. Elaborating further, they assert that definitions describe the components of vulnerability such as exposure, sensitivity, and adaptive capacity, whereas conceptual frameworks give meaning to properties of those concepts in order to analyse them objectively and repeatedly (Nelson et al., 2010). Likewise, Wisner (2016) argues that both metrics and tools depend on conceptual models which depend on definitions of the concept. According to him, models can also be seen as elaborated versions of definitions (Wisner, 2016). In addition, Janssen and Ostrom (2006) stress that it is crucial to understand the term “vulnerability” when it is used in a climate change context before moving to conceptual models or approaches. These arguments also support Adger’s (2006) emphasis that the definition of vulnerability and its associated conceptual model need to be clearly articulated in the early stages of this form of research, notwithstanding the role of research questions in guiding the research. In other words, he emphasized that a clear definition of the concept of vulnerability is as important as the research aims and objectives. Accordingly, this chapter discusses conceptual definitions and the operational metrics of those definitions—termed “approaches”—as separate entities.

2.5.1 Arriving at a Definition

The definition of vulnerability has evolved due to its applicability in many diversified fields of research (Kelly & Adger, 2000). Different disciplines define vulnerability according to their context. The definition also changes and progresses with developments in respective disciplines, thus convoluting its meaning (Adger, 2006; Fuller & Pincetl, 2015; Wisner, 2016). In Cutter's (1996) view, these variations and inconsistencies arise from four main traits of vulnerability research: different epistemological stances (e.g., political ecology or physical science); subsequent methodological practices used to examine vulnerability (e.g., qualitative, or mixed); choices of hazards (e.g., floods or famine); and different places of examination (e.g., developed or developing). In fact, Timmerman (1981), whose work is regarded by Cutter (1996) as one of the best early conceptualisations of vulnerability, states "vulnerability is a term of such broad use as to be almost useless for careful description at the present, except as a rhetorical indicator of areas of greatest concern" (p. 17). Therefore, in this study only the definition that is of interest to the main research question will be carefully discussed, primarily to avoid confusion and to focus on the study's objectives.

One of the most cited articles on vulnerability by Adger (2006) defines vulnerability as "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt" (p. 268). He gives specific reference to livelihoods and defines social vulnerability as: "the exposure of groups or individuals to stress as a result of social and environmental change, where stress refers to unexpected changes and disruption to livelihoods" (Adger, 2006, p. 268). Timmerman (1981) defines vulnerability as "the degree to which a system acts adversely to the occurrence of a hazardous event. The degree and quality of the adverse reaction are conditioned by a system's resilience (a measure of the system's capacity to absorb and recover from the event)" (as cited in Cutter, 1996, p. 3). Similarly, Kelly and Adger (2000) define vulnerability "in terms of the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being" (p. 328). Turner II et al. (2003) view vulnerability as "the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressor" (p. 74). Likewise, Chambers (1989) one of the first to introduce the term "vulnerability" into the analysis of rural poverty (Wisner, et al., 2004) refers to it as "exposure to

contingencies and stress, which is defencelessness, meaning a lack of means to cope without damaging loss” (p. 1).

The seminal work of Cutter demonstrates vulnerability as an inherent attribute of a community that determines the extent of the damage caused by an external or internal perturbation in addition to the magnitude of the hazard itself (Cutter, 1996, 2003). It explains the ways in which these attributes are adjusted and altered by the previous experience and coping capacities of these communities. Likewise, Cutter et al. (2003) characterise vulnerability as likely damage that a hazard can cause that can be different from place to place and also that depends on the time factor. In fact, Cutter’s work clearly recognises the significant role of geography in vulnerability science, making this explicit in her “hazard of place” model (Cutter, 1996; Cutter, 2003; Cutter et al., 2003). In line with that, Orencio and Fuji (2013) state the importance of the locus of households in determining the attributes of the communities through aggregation. This means vulnerability is subjective to the place that the community lives in. According to the United Nations International Strategy for Disaster Reduction (UNISDR, 2004), vulnerability is a combination of conditions and processes that intensify the community’s susceptibility to impacts of hazards and risks, experienced in four main categories: social; economic; physical; and environmental. Likewise, Klein and Nicholls, (1999) claim that vulnerability to impact is a combination of bio–geophysical, sociocultural, institutional, and economic factors, making it a multifaceted phenomenon. Thus, their definitions incorporate the engagement of different sectors in constructing vulnerability.

Despite the number of definitions and interpretations available in climate science related disciplines, the majority of researchers seem to be relying on the IPCC definition (Hahn et al., 2009). The IPCC is considered the leading international scientific institution that works on climate change (Fellmann, 2012); thus, its influence on research and policy is substantial (Fussel & Klein, 2006). The IPCC (2001) defines vulnerability as:

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. (p. 995)

However, this IPCC definition is criticised by Downing et al. (2001) for being incomprehensible and by Brooks (2003) for positioning “or” between “susceptible to and unable to cope with”, as he believes “or” should better be replaced by “and” as they are co-factors not just independent alternatives that define vulnerability. The IPCC definition still seems to predominate climate change related studies. Each factor in this definition further delineates the scope that it addresses in a broad way.

Exposure is the degree to which a system is exposed to a particular hazard, whereas sensitivity refers to how prone the system is to being affected by a likely hazard and the degree to which it is impacted. Adaptive capacity is the system’s ability to cope with consequences of the threat or impacts of climate change, or ability to exploit its advantages. According to this definition, the hazard is not the sole determinant of the level of damage caused—the exposure, sensitivity, and adaptive capacity of a community, place, or a system together determine the level of damage (IPCC, 2001). A system is less vulnerable to climate change if it is less exposed, less sensitive, or has high adaptive capacity (Smit & Wandel, 2006). However, a highly exposed and/or sensitive system is not always vulnerable to the climate threats to which it is exposed, because neither of those components account for adaptive capacity (Fellmann, 2012). That is, adaptive capacity regulates the overall vulnerability of the system regardless of the level of its exposure and sensitivity (Gallopín, 2006; Yohe & Tol, 2002). These relationships, together with their practical implications, are further elaborated in Chapters Five, Six, and Seven of this thesis.

Overall, these definitions of vulnerability to climate-related impacts seem to broadly ascribe the elements that govern vulnerability in different domains to various temporal and spatial settings (Fuller & Pincetl, 2015). There seems to be agreement on three main constituents despite the use of different terminologies: exposure, sensitivity, and adaptive capacity of a system of concern. Adger (2006) argues that these are the main themes addressed in vulnerability research. The differences between definitions are mostly variations on a common theme, even though the emphasis on each of the factors varies between definitions. This study adopts the IPCC definition, as it incorporates the three primary factors that many scholars agree can effectively structure vulnerability discourse.

The IPCC definition also aligns with the third school of thought which describes vulnerability as a concept that incorporates both external (e.g., exposure) and internal (e.g., sensitivity and adaptive capacity) dimensions (Fussler & Klein, 2006, p. 306). As is

widely accepted in climate change research, it facilitates the use of qualifiers (Fussel & Klein, 2006). The consistent use of terminology could facilitate and contribute to vulnerability literature despite the differences prevailing in conceptual models applied by different stakeholders in varied disciplines (Brooks, 2003; Downing & Patwardhan, 2004; Fussel, 2007). Fuller and Pincetl (2015), who conducted a literature review of vulnerability research, note the significance of having a consensus about terms and theoretical concepts. This working definition of vulnerability—which is fundamentally a relative concept (Downing et al., 2001; Eakin & Luers, 2006)—is derived from an understanding of the social dimensions of households, communities and livelihoods that are directly relevant to policy and practice. Despite the broad applicability of the concept of vulnerability in numerous fields, Eakin and Luers (200, p. 366) argue that the main elements of the function of vulnerability (exposure, sensitivity, and adaptive capacity) and their interrelationships are not yet well defined and clarified, are required further research.

Most importantly, in addition to its simplicity, the definition has a broad and deep scope, facilitating a holistic view of vulnerability which in turn assists policy development. Thus, it is appropriate to use this definition of vulnerability to answer my research question: “How can the closer knowledge of perception and livelihood vulnerability of coastal communities assist adaptation to offset the effects of climate change impacts?” The selection of a conceptual approach that employs the IPCC definition is discussed in the following sections.

2.5.2 Approaches to Climate Change Vulnerabilities

Cutter (1996) and Cutter et al. (2003) classified vulnerability as (1) an exposure; (2) a social condition; and (3) as an integration of both exposure and social condition with specific reference to geography which they referred to in simple terms as place-based vulnerability. However, analysing vulnerability research across several domains, Eakin and Luers (2006) identify three main approaches used in climate change research: risk hazard; political economy/political ecology; and ecological resilience. While appreciating diverse yet complementary approaches in vulnerability research, their categorisation is primarily based on the following elements of the vulnerability studies they analysed: primary focus, key attributes, exposure unit, scale or scope of the research, and the definition of vulnerability adopted.

Adger (2006, p. 375) proposes seven approaches to vulnerability research under two main headings “antecedents” and “successors”, or in simple terms “past” and “present” research. Accordingly, Adger’s first category discusses four approaches: vulnerability to famine and food insecurity; vulnerability to hazards; human ecology; and pressure and release which defines risk as a product of both the hazard and vulnerability. However, he asserts that a pressure and release model is a successful combination of hazard vulnerability and human ecology. The “successors” consist of three main vulnerability approaches: vulnerability to climate change and variability; sustainable livelihoods and vulnerability to poverty; and vulnerability of social ecological systems.

Similarly, Fussel (2007) introduces five main approaches: risk hazard; political economy; pressure and release; integrated approach; and resilience. However, his reference to these approaches is predominantly based on two main independent dimensions that he termed “domain” and “sphere.” Domain refers to the area of research interest, which he further divides into socioeconomic and biophysical categories. The sphere is defined as the internal or external scale within which a study operates, i.e., whether the factors that determine vulnerability of a system or a unit that a researcher wants to focus on lie outside the system or inside the system. Internal factors include household income, while external factors include national policies.

A 2014 literature review on vulnerability assessment conducted by Moret (2014) discusses three perspectives of vulnerability based on the discipline in which it is applied. They are disaster management, ecology and hazards perspectives; anthropology or sociology perspective; and economic perspective. Accordingly, following the claims made by Adger (2006) he divides the hazard perspective of vulnerability into two schools of thought—the behavioural paradigm and the structural paradigm. The former interprets vulnerability as a failure to cope due to a poor perception of the hazards and risks associated with the forces created by nature (Burton et al., 1993) while the latter conceives it as a social and economic condition. By comparison, the sociological perspective describes the fundamentals of poverty and its multidimensionality. It explains the role of social institutions and power in creating vulnerability. Likewise, the economics perspective conceptualises vulnerability according to poverty dynamics; food security; and the sustainable livelihood approach (Moret, 2014).

In addition to these different classifications, O'Brien et al. (2004) elaborate two very different interpretations of the term vulnerability, namely "starting point" and "end point". These were initially developed by Kelly and Adger (2000). A starting point interpretation views vulnerability as a state or a pre-condition caused by varied social and ecological processes that are intensified by climate change. In contrast, an end point interpretation recognizes vulnerability as a residual effect that is "impact minus adaptation" (Kelly & Adger, 2000; O'Brien et al., 2004). Accordingly, the end point interpretation primarily addresses two questions: "what is the degree of the climate change problem?" and "do the costs of climate change surpass the costs of greenhouse gas mitigation?" whereas the starting point interpretation attempts to find answers for "who is vulnerable to climate change and why?" and "how can vulnerability be reduced?" (O'Brien et al., 2004, p. 3). The type of interpretation is mainly governed by the type of adaptive capacity in place. In the "starting point interpretation," the ability to adjust to changing social ecological systems is taken into account, whereas in the "end point interpretation", the feasibility of conducting planned adaptation is considered (O'Brien et al., 2004).

While there are similarities between each of these approaches (Eakin & Luers, 2006, pp. 386–387), each has distinguishing attributes due to the different purposes they serve and different researchers' objectives. For example, the resilience approach is popular in ecology, where it originated. Therefore, the resilience approach is not given significant consideration in this study, although the concept of resilience is briefly elaborated in relation to vulnerability later in section 2.6.2, recognising the work of scholars who use it interchangeably in vulnerability science. Further, as stated by Eakin and Luers, (2006), a pressure and release model describes the causal factors of disasters and the ways in which risk is created by social factors, thus it is vastly used in emergency management. Even though the political ecology approach analyses social dynamics as in political economy, it gives equal priority to biophysical dynamics unlike the Pressure and Release model (Adger et al., 2001; Eakin & Luers, 2006). The political ecology approach is therefore beyond the scope of this thesis.

Overall, the most prevalent approaches in the context of climate change seem to be risk hazard, political economy, and integrated. These approaches facilitate the discussion of various other approaches within their boundaries. For example, the approaches of

vulnerability to climate change, sustainable livelihoods and poverty as classified by Adger (2006) can easily fit into the broader concept of “political economy”. Furthermore, the “starting point interpretation” of vulnerability commends political economy as the approach that would follow its fundamentals. Therefore, the following section focuses on these three vulnerability approaches that are popular in climate change-related livelihood vulnerability research. The aim is to determine the approach that best accommodates our research objectives and delivers theoretical insights about livelihood vulnerability, while strengthening practical aspects of it.

2.5.3 Deciding on an Approach

The risk hazard approach is predominantly driven by technical rationality that focuses on three broad concerns: “(a) to what we are vulnerable; (b) its consequences; and (c) the time (when) and place (where) those impacts may occur” (Eakin & Luers, 2006, p. 369). Consequently, it estimates the risk of a particular hazard to valued components in a system (Kates, 1985), that is to certain exposure units, typically locations and built infrastructure (Fussel, 2007). In other words, this approach views vulnerability as a single outcome of a single stressor (Burton et al., 1993) Therefore, it works inductively and considers hazard as the primary unit of analysis, thus often relying on modelling approaches and technical solutions (Brooks, Adger, & Kelly, 2005; Eriksen & Kelly, 2007; Fussel & Klein, 2006). It estimates the residual impact of a hazard after adaptation has taken place (Eriksen & Kelly, 2007). Therefore, it largely corresponds with the end point interpretation of vulnerability (Fussel & Klein, 2006; O’Brien et al., 2004).

According to the paradigm where it is applied, the risk hazard approach is also referred to using other terminology. For example, in natural hazard research, the same approach is named “hazard–loss relationship”, whereas in epidemiology it is termed “dose–response relationship” or “exposure effect relationship”. Economists describe it as “damage function” (Fussel, 2007, p. 160). According to the terminology introduced by Fussel (2007), it is termed “internal bio–physical vulnerability.” He also argues that the risk hazard approach broadly corresponds with the “geocentric” approach of Kasperson et al. (1995), making it inappropriate for understanding vulnerabilities largely determined by perceptions (Grothmann & Patt, 2005; Kuruppu & Liverman, 2011) and behaviour of the people and associated socioeconomic and political factors that demand explanation (Cutter et al., 2009). Nelson et al. (2010) argue that this use of hazard and impacts

modelling to develop adaptation policies alone is not sufficient to deal with the multidimensional uncertainties of climate change.

This understanding of vulnerability as a broad concept that goes beyond just the hazard and its impact in a physical environment but also its role in the socio-economic and political environments (Morrow & Phillips, 1999), demands a different approach. The seminal work of Hewitt (1983), who strongly criticised the technocratic nature of natural hazard research, provided a different avenue through which to investigate vulnerability. Thus, the political economy approach emerged. This is also referred to as “internal socioeconomic vulnerability” or “cross-scale socioeconomic vulnerability”, according to the lexicon introduced by Fussler (2007).

The political economy approach answers two basic questions: “who is most vulnerable?” and “why they are vulnerable?” (Eakin & Luers, 2006; Fussler, 2007; Ribot, Najam & Watson, 1996). This people-centred approach is commonly used in poverty and development literature (Fussler, 2007), including food security (Eakin & Luers, 2006) and climate change-related research (Tanner & Allouche, 2011). Its interpretation of vulnerability predominantly evaluates the influence of socio-political, economic, and cultural factors that together describe the varied exposures, impacts, sensitivities, and coping capacities (both to present and future threats) in the context of human environment systems (Eakin & Luers, 2006). A study conducted by Liverman (1990) on the impacts of drought in Mexico revealed that the precipitation patterns as well as access to resources and land tenure patterns play a crucial role in determining crop yields during droughts. The importance of inclusion of socioeconomic factors in vulnerability studies was recognised as long ago as 1990. It has been acknowledged that this approach facilitates the starting point (Kelly & Adger, 2000; O’Brien et al., 2004). Both the starting point interpretation of vulnerability and political economy approach to vulnerability share similar understandings—both consider the root problem of vulnerability as social vulnerability, which is a condition.

On the other hand, the integrated approach, as defined by Fussler (2007) and Eakin and Luers (2006), permits the combination of a number of varied analytical approaches, most notably coupled with vulnerability frameworks (Turner II et al., 2003). A good example of this is the pressure and release model which characterises the features of human ecology, political economy, and hazard vulnerability (Blaikie et al., 1994; Pelling, 2003) and

describes disaster as the coming together of two essentials, namely, vulnerability of a system and natural hazards in place (Adger, 2006; Eakin & Luers, 2006; Wisner et al., 2004). The “double exposure” project (O’Brien & Leichenko, 2000; O’Brien et al., 2004) that analyses the joined impact of climate change and economic globalisation also provides an example of the integrated approach. The hazard of place model which combines both internal aspects of the system and its exposure to external hazards to determine the vulnerability (Cutter, 1996; Cutter, 2003), is an integration of the most popular two opposing models, the risk hazard and political economy (Fussel, 2007).

Despite the importance of each approach in identifying and clarifying varied facets of vulnerability, I argue that the political economy approach as a whole provides a clear path to finding answers to the questions driving this research. Further, livelihood vulnerability, which is related to Sen’s (1981) social choice theory and the capability approach, provides a basis for the political economy approach, because of its exposition on entitlements, capabilities, and social inequities of the people and the environment that they live in (Sen, 1981; Bohle et al., 1994). Therefore, it facilitates the discourses of the capital approach, which in turn assists vulnerability and adaptation science. As argued by Tanner and Allouche (2011), taking a political economy approach will improve the understanding of the complexity of climate change decision making and policy processes, including understanding differences in governance and planning systems, the power relations mediating competing claims over resources, and the contextual conditions for enabling the adaptation including adoption of technology depending on context. The political economy approach also recognises the need to understand global drivers that influence domestic processes (Tanner & Allouche, 2011). In addition, the approach accommodates the cross-cutting nature of climate change issues and associated diversity (Rabe, 2007), which often demand integration of policy and practice (Reid et al., 2009).

Bohle et al. (1994, p. 37) claimed that vulnerability is limited by political economy, entitlements, and empowerment. This provides an argument for selecting the political economy approach for this research project. Most importantly, the political economy approach considers vulnerability as a “starting point,” in other words, as a “condition” that is moderated by the scenarios explained by Sen (1981), Bohle et al. (1994) and Tanner and Allouche (2011). However, in understanding the political economy of climate change I refer mainly to the scholarly work of Adger (1999) and Tanner & Allouche (2011). Accordingly, the study adopted the definition of Tanner & Allouche

(2011) who define political economy as “the processes by which ideas, power, and resources are conceptualised, negotiated, and implemented by different groups at different scales” (p. 2).

These diverse conceptualisations which one way or another contribute to the vulnerability literature have steered many studies to converge the meaning of vulnerability in one direction through identification of its basic attributes and relevance to other closely associated concepts like adaptation, resilience, and sustainability (Bene et al., & Davies, 2012; Eakin & Luers, 2006; Nelson et al., 2010). Adger (2006) clearly articulates the challenges that are common to vulnerability research such as deciding on vigorous and reliable measures and the application of different methods that accommodate analysis of people’s perception of risk and vulnerability, adaptation, and resilience, and create common ground for conciliation and integration. This emphasises the need to understand the intricate relationships that vulnerability shares with the associated concepts of perception, resilience, adaptation, and sustainability, to achieve clarity and integration within the context of climate change and its impacts (Adger, 2006; Cinner et al., 2018; Eakin, Lemos, & Nelson, 2014; Fuller & Pincetl, 2015; Fussel & Klein, 2006; Smit & Wandel, 2006).

2.6 Concepts Associated with Vulnerability

Cutter (2003) clearly articulates the substantial role of vulnerability science and its policy potential in relation to climate change. Her argument is primarily premised on its ability to be integrated with other subjects like risk, hazard, susceptibility, resilience, adaptation, and sustainability, to achieve the common goal of understanding and responding to the factors that put people and places at risk. However, this study’s literature review on vulnerability science suggests that analysis of livelihood vulnerability with the goal of reducing climate change impacts cannot be undertaken without a clear understanding of associated concepts such as perception, adaptation, and sustainability. A brief review of the concept of resilience, which some scholars and practitioners use interchangeably with vulnerability, is presented in this study to provide further clarity about the concept of vulnerability, and its relevance. Significantly, Grothmann and Patt (2005) stress the critical role of perception in minimising livelihood vulnerabilities. Therefore, the following discussion addresses four main concepts that either define overall vulnerability and clarify its traits or decide its fate—perception, resilience, adaptation, and sustainability.

2.6.1 Vulnerability and Perception

In the 1940s, the seminal work of White (1945), and later that of Burton et al. (1993), redefined the academic discourse of natural hazards by highlighting the significance of encompassing people's perceptions and awareness of risk and their natural hazard management decisions, in addition to the focus on the most popular hydrological engineering options designed to withstand the impacts of natural hazards. Macdonald et al., (2011) regard the influential work of Gilbert White highly, since he revealed additional paths into the domain of natural hazard discourse via his introduction of "forms of adjustments" (White, 1961, p. 37–38) such as the feasibility of emergency adjustments which take social processes into account. This conveyed the notion of sustainable resource management and application of science beyond the academy, seven decades ago. Weber's studies (1997, 2010) further establish the power of cognitive variables like perception and expectation in farmers' decisions about adaptation strategies to offset the impacts of climate change. In addition, Weber (2010, p. 332) argues that psychological factors like perception can assist policies through promoting convergence of beliefs and willingness to act. Equally, based on their empirical study, Bryan et al. (2009) state that it is vital for policy makers who work on food security to understand and respond to farmers' perceptions of climate change.

Anderson and Woodrow (1991, p. 45) claim that overall, vulnerability is an outcome of three main spheres: motivational, social, and physical. Thus, they grant equal significance to peoples' cognition and the contextual dimensions of vulnerability. Likewise, in vulnerability science it is important to understand how people estimate risk, and the ways those risk cognitions are translated into behaviours (Cutter, 2003; Grothmann & Patt, 2005). The application of good science and expansion of the cognitive boundaries of people at risk can create effective policies (Wisner, 2016). However, the vital role of psychological factors in climate related vulnerability science is often overlooked (Grothmann & Patt, 2005). Therefore, this study predominantly addresses the cognitive factor of perception, in particular risk perception and perceived adaptive capacity, with specific reference to livelihood vulnerability. This is undertaken to achieve two main objectives: examination of the levels and contextual determinants of perception, followed by investigation of the ways in which those factors are translated into behaviours. Thus,

the relationship between livelihood vulnerability and perception is shown to exist. This relationship is discussed at length in Chapters Six and Seven.

2.6.2 Vulnerability and Resilience

Resilience was originally a concept applied in ecology (Bene et al., 2012), although it later featured repeatedly in development literature (Moret, 2014). Some scholars (e.g., Berkes et al., 2008; Carpenter et al., 2001) characterise resilience as the capacity of a social and ecological system to absorb disturbance without changing its current state, and a system's ability to adapt to evolving situations created by the disturbance. The IPCC (2012) defines resilience more comprehensively as:

The ability of a system and its component parts to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration or improvement of its essential basic structures and functions. (p. 563)

Therefore, the concept of resilience exemplifies the notion of coping capacity and is responsive to human activities. For example, a planned adaptation that has a positive effect on human communities can simultaneously enhance the resilience and resistance of natural systems. It can also assist the effectiveness of autonomous adaptation (spontaneous acts of reducing risks without any planning or without being forced) (Klein & Nicholls, 1999). In addition, resilience itself is a process that matures with time through learning and experience (Madhuri et al., 2014). This exemplifies its dynamic nature, one of the shared attributes of vulnerability and resilience.

In simple terms, in climate change research, vulnerability implies a negative term while resilience has positive connotations (Adger, 2006; Xiaolei et al., 2011). The concept of vulnerability clarifies risk factors, whereas resilience explains the factors associated with the concept of coping. However, resilience does not elucidate the role of power and agency like the concepts of vulnerability and sustainability (Bene et al., 2012). On the contrary, Adger (2006) argues that both vulnerability and resilience discourses encompass attributes of social ecological systems and elements such as stress, exposure, and absorbing and adaptive capacity. Thus, they have more fundamental similarities than disparities, making them complementary concepts (Adger, 2006). Moret (2014) stresses the significance of the concept of resilience as a subject of similar importance as that of

vulnerability, giving both concepts equal recognitions, while Bene et al. (2012, p. 15) refer to it as a sibling concept to vulnerability.

Several arguments exist about the possible relationships between vulnerability and resilience. The United Nations Disaster Relief Organisation claims that vulnerability and resilience are two separate entities (United Nations Disaster Relief Organisation [UNDRO], 1982). Similarly, Manyena (2006) describes them as two distinct entities, but not exact opposites as Herzberg does in the two-factor theory which holds that the absence of one does not necessarily mean the presence of the other. The study conducted by Madhuri et al. (2014) in India confirms this, further stating that neither of them influences the other. Yet, they claim that absence of vulnerability substantiates the presence of resilience but does not guarantee sustainability.

In contrast, Turner II et al. (2003) argue that vulnerability and resilience are two strongly related notions where adaptive capacity and resilience are essentially the components of vulnerability. Furthermore, Turner II (2010) emphasizes that both vulnerability and resilience are crucial concepts in sustainability science. In line with this argument, Magis (2010) claims that resilience is an important indicator of social sustainability and defines community resilience as “the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise” (p. 401). Similarly, Adger (2006) asserts that resilience can influence the vulnerability of social or ecological systems by building up or eroding its elements. Reinforcing this view, Cassidy and Barnes (2012) claim a direct relationship between the amount and diversity of household assets and their respective adaptive capacity and resilience. This in turn proves the strong alliance between vulnerability and resilience, because adaptive capacity which encompasses all natural, social, economic, and political systems, is an integral concept of the construct of vulnerability. In fact, the notion of adaptive capacity is prominently and frequently used together with the concept of vulnerability (Moret, 2014). On the other hand, many scholars agree that adaptive capacity is often used interchangeably with the concept of resilience and with several other concepts such as coping capacity, adaptability, robustness, stability, flexibility, and management capacity (Adger & Kelly, 1999; Brooks, 2003; Fraser, 2003; Fussel & Klein, 2006).

In all formulations, the phenomena of vulnerability and resilience clearly demonstrate a robust relationship, even though the type of relationship they share within the scope of climate change—whether contrasting, coalescing, or complementary—is still debatable. However, the concept of resilience has constantly been used and is well regarded in ecological science (Berkes et al., 2008), whereas adaptation and adaptive capacity manifest a distinct and definite relationship with vulnerability in climate science. Thus, the utility of those two concepts is clearly applicable to this study. However, adaptive capacity—rather than resilience—constitutes a main element of the chosen IPCC definition of vulnerability, thus earns its place in this research. Therefore, the following section reviews the broader concept of adaptation with specific reference to adaptive capacity and vulnerability, leaving resilience to ecological studies, the domain where it has its roots.

2.6.3 Vulnerability and Adaptation

These two concepts, each of which has evolved into a vital subject in climate change related studies, are inextricably linked (Luers et al., 2003; O'Brien et al., 2004; Smit & Wandel, 2006). In fact, assessment of adaptation is an integral part of present-day climate-related vulnerability assessments (Grothmann & Patt, 2005) and is also considered a much-needed response to climate change impacts (Adger & Barnett, 2009). In Tanner and Allouche's view (2011), assessment of adaptation can contribute to sustainable poverty reduction. Consequently, its definition varies according to where (context) and how it is applied (practice) (Moser & Ekstrom, 2010).

Brooks (2003) defines adaptation as “adjustments in a system's behaviour and characteristics that enhance its ability to cope with external stress” (p. 8) whereas Pielke (1998, p. 159), outlines it as the “adjustments in individual groups and institutional behaviour in order to reduce society's vulnerability to climate.” More recently, Elum et al. (2017) delineate adaptation as “a means of strengthening resilience of individuals and systems to climate change and climate variability” (p. 248). Likewise, the Fourth Assessment Report of IPCC defines adaptation as “initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects” (IPCC, 2007, p. 809). This supplements the early version of the definition of Smit and Pilifosova (2001, p. 881): “adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts.” Several other

scholars define adaptation in a similar fashion, while identifying adjustments either as moderating harm or realizing benefits. So, for them, adaptation entails adjustments in the natural and/or human environment systems in response to actual and/or expected climatic stimuli and/or associated effects which take place in order to moderate harm or to realise potential opportunities (Fussel & Klein, 2006; Grothmann & Patt, 2005; Wheeler et al., 2013).

For the most part, the definition of adaptation in the context of climate change seems to entail several main elements despite any particulars added onto it depending on the contexts discoursed and researchers' interest. They are the system/s of concern, the impacts of climate change upon those systems, and the respective responses. Within this broad frame, the IPCC's (2007) definition of adaptation was chosen for the study with slight modifications by acknowledging the fact that impacts of climatic and non-climatic factors are hard to differentiate, and so are respective responses (IPCC, 2007; Parry, et al., 2007). On the other hand, the literature on the practical application of climate adaptation reveals that respective policies never stand alone. Instead, they are integrated or mainstreamed into other programmes or policies such as coastal zone management and sustainable development goals (Smit & Wandel, 2006; Eakin et al., 2014). The studies that focus on people's adaptive capacities suggest that adaptation actions are taken to combat combinations of disturbances not just to contest the stresses of climate change (Smit & Wandel, 2006).

Therefore, for this study I define adaptation as "any type of initiative and measure that contributes to moderate the vulnerability of coastal communities and their livelihoods to both direct and indirect effects of climate change impacts, weather related stresses, and stresses that put their livelihoods and wellbeing at stake." For instance, I consider borrowing money from an external source either to educate a child or to construct a permanent house to be an adaptation measure based on the ability of such acts to reduce their climate-related vulnerabilities and ensure wellbeing of the members of the household.

Despite the elements that define adaptation listed above, the concept as a whole encompasses a range of attributes. Accordingly, many view adaptation as a process that evolves through continuous learning and reflection (Adger & Vincent, 2005; Folke, 2006; Kelly & Adger, 2000; Risbey et al., 1999). In their purview of the human dimensions of

global change, Smit and Wandel (2006) refer to it as a process, action or outcome in a system. They define system as the type of unit, household, group, community, sector, region, or even country. Kane and Shogren (2000) also claim climate change adaptation as an action that can be considered self-insurance to adverse climatic events. From a different perspective, Grothmann and Patt (2005) claim that adaptation is a process that is subject to an individual's cognition. According to their Model of Private Proactive Adaptation to Climate Change (MPPACC), the process starts with a risk appraisal followed by an adaptation appraisal which then results in avoidant maladaptation or adaptation intention and ultimately the adaptation action. However, adaptation is not a novel concept, as climate has always been an integral element of human habitation (Adger, 2003; de Menocal 2001). Thus, communities usually understand their environment together with associated risks and develop corresponding coping mechanisms accordingly (Krishnamurthy et al., 2011; Rahman, 2014; Tran et al., 2009). Hence, adaptation is responsive to temporal and spatial variations (Kuruppu & Liverman, 2011) and takes different forms.

The IPCC (2001, p. 982) suggests a few main forms of adaptation prominent in climate change research. These are: anticipatory and reactive, or as some others term it, proactive and reactive adaptation; autonomous and planned adaptation; and private and public adaptation. Accordingly, the first form is associated with the timing of adaptation as to when adaptation takes place; that is whether before or at the onset of the event while the second form reflects its degree of spontaneity or intent. Based on spatial traits, adaptation can be either local or widespread (Fankhauser et al., 1999; Smit et al., 2000; Smit & Wandel, 2006). Autonomous adaptation of a system is a self-directed adaptive response to a stress whereas planned adaptation involves measures put in place to address identified circumstances with an intention to minimise or eliminate them. Private and public adaptation on the other hand is characterised by the different actors that initiate the measure. As Smit and Wandel (2006) state, adaptation can even be distinguished based on its form, be that informational, behavioural, technological, financial, or institutional. Similarly, Risbey et al. (1999) argue that adaptations can have different forms, based on the degree of adaptation required by the system. For example, people may have to shift to a different fishing method, to a different species of fish, or even

abandon a fishery altogether. Adaptation decisions are made at all levels: individuals, households, groups within the society, organizations, and governments (Adger, 2003).

The act of adaptation, however, is challenged by a few factors. The uncertainties associated with projections of future climate change impacts make it difficult to design and implement the most appropriate adaptation measures (Scheraga & Furlow, 2001). Also, the broad scale within which adaptation decisions occur demonstrates that trade-offs between those decisions are inevitable and that there will always be winners and losers (Adger, 2003, p. 388). Some also argue that it is challenging to measure the effectiveness of adaptation because difficulties prevail in measuring the very impacts evaded by the act (Moser & Ekstrom, 2010). Nonetheless, Fussel and Klein (2006) describe two main determinants of effective adaptation: the availability of accurate information, particularly on what and how to adapt, and the transfer of required resources to the system of concern. This partly answers the challenge by ensuring that adaptation takes place at the right location on the right scale, even though it does not precisely measure all types of vulnerabilities evaded by the act of adaptation.

Adding to this, Adger (2003) claims that the efficacy of adaptation strategies is determined by social acceptability, institutional constraints, and the positioning of adaptation in the wider landscape of economic development and social evolution. O'Brien and Leichenko (2000) claim such strategies are also subject to the compounding effects of economic globalization and other trends. Although the view of adaptation as primarily "local work" (e.g., Eakin et al., 2014; Lambert et al., 2011) is supported by many scholars (Nalau et al., 2015), a few argue that it is no longer limited to "local context" as certain elements that regulate or succeed adaptation are global or international (e.g., NRC, 2010). These arguments exemplify the notion that the effectiveness of adaptation measures is governed by several factors at various scales, although it is challenging to assess the efficacy of those factors. Nonetheless, Dilley and Boudreau (2001) state that vulnerability studies provide a large number of assessments which disclose constraints to adaptation.

Resource limitation is often documented as the main constraint to adaptation, while some scholars add psychological aspects (Grothmann & Patt, 2005; Kuruppu & Liverman, 2011). Some resource limitations are: wealth of the nation; absence or lack of data and respective literature; inadequacy of finance; limitations in institutional and technological capacities; prevailing social attitudes and trends; and political barriers (Ford & Berrang-

Ford, 2011; Grothmann & Patt, 2005; Klein et al., 2014; Kuruppu & Liverman, 2011; Moser & Ekstrom, 2010). It is evident that households that are vulnerable and neglected by their governments use their own resources to implement their own adaptation strategies (Madhuri et al., 2014).

Adger and Vincent (2005) argue that adaptation measures that are fundamentally guided by vulnerability studies in relation to coastal communities have become more crucial in the official discourse of either governments or private agencies. Similarly, Fussel and Klein (2006) claim that limits to adaptation can intensify the vulnerabilities of systems. However, adaptation is assisted by various policies such as establishment of better communication channels to deliver climate related information to ground level, institutionalised insurance schemes (Adger, 1999, 2000a; Patt & Gwata, 2002), and provision of grants and financial support, together with incentive schemes to the impoverished (Klein, 2002). These were seen in the past as the most reliable methods to overcome the institutional, informational, and financial constraints to adaptation (Berkes & Jolly, 2002; Kelly & Adger, 2000), whereas psychological aspects of adaptation have often been overlooked despite their vital role (Grothmann & Patt, 2005). Thus, they are a key focus of this study.

As the viability of adaptation is fundamentally determined by the adaptive capacity of the systems of concern, the determinants of adaptive capacity govern its proposition (Fussel & Klien, 2006; Smit & Wandel, 2006). Adaptive capacity, on the other hand, is one of the main aspects of vulnerability (IPCC, 2007), and is the basis on which many argue the relationship exists between vulnerability and adaptation (e.g., Turner II et al., 2003; Wisner et al., 2004). This standpoint also supports the work related to the United Nations Framework Convention on Climate Change (UNFCCC), Article 4.4, that demonstrates the need of assistance for developing countries to reduce their vulnerabilities either through minimising exposures or increasing their adaptive capacities (Smit & Wandel, 2006). Additionally, Harvey and Nicholls (2008) claim that lack of adaptive capacity often determines the extent of vulnerability of human systems.

In that regard, there exist several definitions of adaptive capacity. The IPCC (2007) defines it as: "The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures" (p. 809). Brooks and Adger (2004) outline adaptive capacity as "the set of resources (natural, financial, institutional or human, and

including access to ecosystems, information, expertise, and social networks) available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation” (p. 168). Fellmann (2012) concisely interprets adaptive capacity as “the capacity of a system to adapt in order to be less vulnerable” (p. 20). Elaborating further he states that it has two dimensions: ability to cope and ability to change. In a rather different perspective that gives precedence to context specificity, Eakin et al. (2014, p. 1) postulate two different dimensions of adaptive capacity: generic and specific. Brooks (2003) also notes the same dimensions in his report that introduces a tentative conceptual framework for studies of vulnerability and adaptation to climate change.

Therefore, adaptive capacity is determined by various and numerous social, cultural ecological, political, economic, institutional (Fellmann, 2012), and psychological factors (Grothmann & Patt, 2005). It is subject to the resource endowments of households and whether there is an enabling environment that facilitates adaptation (Yohe & Tol, 2002). The adaptive decision making process itself is characterised by uncertainty and change, and the ability to respond to them (McDonald et al., 2011). The determinants of adaptive capacity and its attributes are further addressed in Chapter Five of this thesis in which the livelihood vulnerability index is discussed.

In summary, despite the existence of different interpretations and terminologies which often accommodate the interests of different researchers, they all apparently agree on one common theme in defining adaptive capacity: the capabilities of the systems that undergo stresses. Therefore, this study adheres to the IPCC’s 2007 definition. Its broad nature facilitates the discussion of livelihood entitlements (Sen, 1981) and resource endowments (Adger, 2003), in relation to adaptive capacity and thereby adaptation. Also, the CLIMSAVE project¹ clearly exemplifies this relationship by adapting capital stocks to quantify adaptive capacity. This line of understanding facilitates the discourses of entitlements and capital approaches benefits and contributes to sustainable adaptation. Engle (2011) claims that adaptive capacity is the central concept in vulnerability and adaptation assessment, while acknowledging its historical relationship with the concept of

¹ “CLIMSAVE is a pan-European project that is developing a user-friendly, interactive web-based tool that will allow stakeholders to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forests, biodiversity, coasts, water resources and urban development”. (<http://www.climsave.eu/climsave/index.html>)

sustainability. Similarly, Eakin et al. (2014) claim that the critical role of adaptive capacity is linking adaptation science and development practice, paving the way towards sustainable adaptation. Subsequently, they argue that climate adaptation and sustainable development goals need to be integrated whenever the conditions that underpin vulnerabilities are addressed (Eakin et al., 2014). Similarly, the National Adaptation Plan (NAP) for climate change in Sri Lanka claims that the aim of adaptation is to accomplish long-term goals of sustainable development via increasing the adaptive capacity of the affected and minimising their vulnerabilities. It clearly articulates that adaptation without sustainability is futile (Climate Change Secretariat [CCS], 2016), thus signifying the role of sustainability in vulnerability science.

2.6.4 Vulnerability and Sustainability

Sustainability has become a vital topic in global environmental discourse, in particular its human dimension (Turner II, 2010) ever since its introduction to interdisciplinary science mainly through the book *Sustainable Development of the Biosphere* (Clark & Munn, 1986) and the well-known *Brundtland Report* (World Commission on Environment and Development [WCED], 1987). While Cutter (2003) and Cutter and Emrich (2006) view vulnerability and sustainability as parallel subjects, Eakin et al. (2014) argue for the power of synergy that those subjects could create together to address the phenomenon of vulnerability and support sustainable adaptation. On the other hand, adaptation originates in the real world as a solution to risks that are already problematic, thus climate-related adaptations are mostly integrated with others like sustainable development programs (Smit & Wandel, 2006). Likewise, many scholars argue that vulnerability should be interpreted and addressed within the scope of sustainability science. The scale of sustainability science in this study however is delimited to the sustainable livelihoods approach, particularly livelihood capitals, owing to its usability and practicality within the study context.

Understanding the role of poverty in complex and multidimensional system or groups like coastal communities requires a broad scope and multidisciplinary approaches. As Sen (1981) argues, the importance of access to resources—not just their availability—is critical in understanding and responding effectively to vulnerability. The guidelines and analytical framework of SLA successfully address the complex and diverse nature of livelihoods of coastal communities, particularly fishing communities, and their associated vulnerabilities

(Allison & Horemans, 2006). This approach usually assists in exploring the impact of climate variability and change on coastal livelihoods through its main components, namely vulnerability context; institutions, policies and processes (IPPs); livelihood strategies (Badjeck et al., 2010); and, in particular, livelihood capitals (Momtaz & Asaduzzaman, 2018).

Chambers and Conway (1992, p. 9) define sustainable livelihood as “a livelihood that can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future while not undermining the natural resources base”. Many sustainable livelihood development approaches associated with vulnerable communities have emerged from this definition. However, the most popular, and the one used in this thesis, is the Sustainable Livelihood Approach (SLA) introduced by the UK Department for International Development (DFID) in 1999. This has subsequently been discoursed, altered, and applied in numerous analytical frameworks and in a diverse range of international development literature, by researchers and other organisations (Glavovica & Boonzaier, 2007). In addition to its extensive applicability, SLA has proven its suitability and usefulness in understanding the degree of vulnerability, adaptability, and resilience of people’s livelihoods, owing to the six core principles upon which the approach is constructed. They are: people centred; holistic; dynamic; building on strength; macro–micro links; and sustainability (DFID, 1999). These principles are discussed below.

The SLA positions people at the centre of development. Thus, everything is discoursed in relation to people (households, communities, or social groups), not just resources, because simple asset creation alone will not resolve the deep-rooted problems associated with development. For example, SLA explains how the vulnerability context impacts upon people's livelihoods. Subsequently the approach attempts to understand all facets that shape people's livelihoods, and how they generate the most beneficial outcomes. In other words, the approach is non-sectoral (thus its applicability in all quarters), acknowledges and recognizes multiple influences, multiple actors, and multiple livelihood strategies that help to achieve multiple livelihood outcomes. For these reasons, it is claimed that SLA is holistic. Even though SLA’s representation is two-dimensional (or linear), it is dynamic as all its components interact with each other across time and space. Furthermore, it explores people’s potentials, to assist in the elimination of any constraints that hinder such potential and ultimately build people's capacity to achieve their goals. Thus, it builds

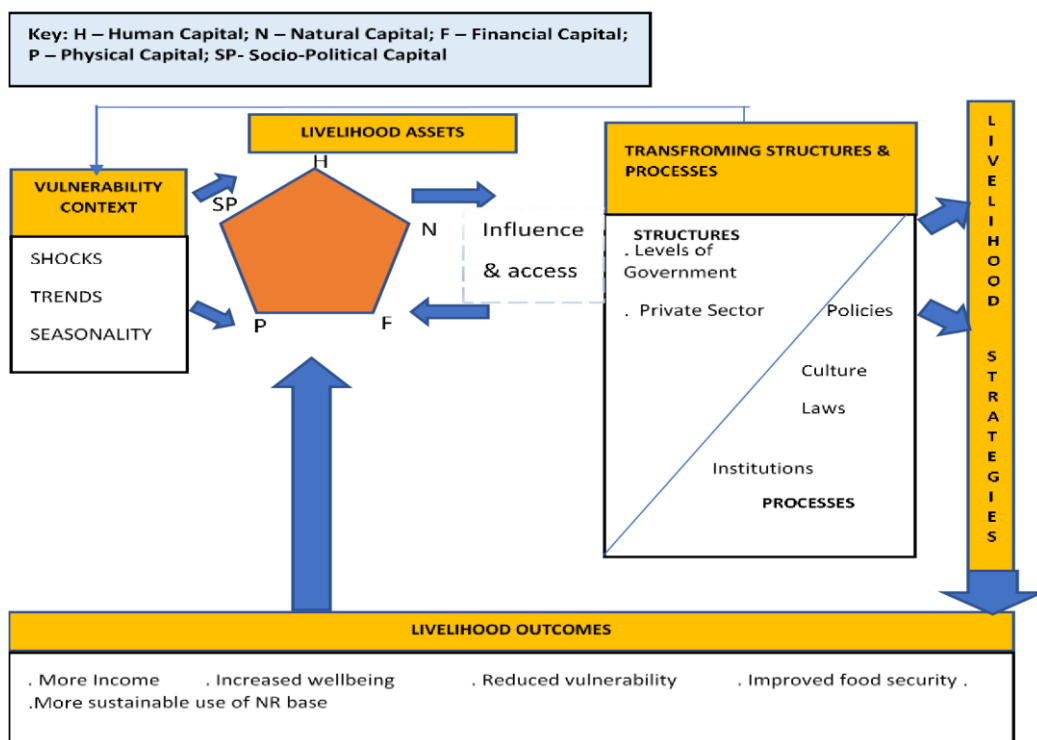
upon strengths. SLA also strives to bridge the gap between macro- and micro-level development activities which often are carried out in isolation. In doing so, it facilitates the flow between developing and implementing policies that affect people and their livelihoods. Accordingly, SLA assists in the achievement of all dimensions of livelihood sustainability (DFID, 1999, Section 1.3) which DFID (1997) outlines as:

resilient in the face of external shocks and stresses; are not dependent upon external support (or if they are, this support itself should be economically and institutionally sustainable); maintain the long-term productivity of natural resources; and do not undermine the livelihoods of, or compromise the livelihood options open to, others. (p. 9)

Together, these key aspects of SLA (see Figure 2.1) can reduce poverty and vulnerability and influence sustainable livelihoods.

Figure 2.1

Modified SLA framework adapted from DFID SLA framework



Note. (Source: DFID, 1999). Modified by author.

As shown in Figure 2.1, the SLA framework encompasses five central themes: livelihood capitals; vulnerability context; institutions, policies, and processes; livelihood strategies; and livelihood outcomes. The central component in the SLA is the pentagon, or livelihood

capitals, that essentially describes people's power and capability in the form of five main capitals: human, natural, financial, physical, and socio-political. The shape of the pentagon schematically demarcates the degree of people's access to those capitals—the centre point of the pentagon represents no access to assets, while the outer perimeter represents maximum access. A complete pentagon therefore symbolizes the maximum access, while a squeezed pentagon epitomizes the opposite. Likewise, differently shaped pentagons can be drawn for different communities or social groups within communities (DFID, 1999, Section 2.3).

Skills, knowledge, and good health that enable people to pursue different livelihood strategies represent human capital. Physical capital is primarily comprised of two things: infrastructure and producer goods. Financial capital can be in the form of cash, credit, and objects that could be easily converted to cash. Social capital represents the networks, connectedness, relationships, and formal and informal groups that are built upon values like trust and needs, such as exchange and sharing (DFID, 1999, Section 2.3). Goods and services produced by the natural environment such as water, trees, wild animals, medicinal plants, and nutrient cycling are defined as natural capital (DFID, 1999; Morse et al., 2009). As argued by Uy et al. (2011), a livelihood will be more secure and sustainable with a larger and more diverse capital base.

Nonetheless, McLeod (2001) suggests including knowledge capital and political capital under livelihood capitals on the basis of their limited representation in human and social capitals, respectively. However, DFID (1999) states that human capital covers all traits, including knowledge in relation to people's livelihoods. This rationalises its exclusion of the suggested additions. However, with SLA delimiting social capital as the social resources upon which people's livelihoods are constructed, it is acknowledged that it does not distinguish between social and political capital. In contrast to the view of DFID (1999), McLeod (2001) argues that the political power of organisations in the community and their institutional capacity determines the direction and speed of the asset formation process. It also defines the ability of households to claim their rights (Momtaz & Asaduzzaman, 2018). In fact, both SLA and rights-based approaches are complementary perspectives because they both attempt to empower the most vulnerable and secure their livelihoods through capacity building. The primary objective of the rights-based approach is to

improve the accountability of public institutions to all citizens (DFID, 1999), thus the significance of politics in climate discourses.

Additionally, the uncertainty that prevails in climate science can stimulate and endorse political demagoguery which can obstruct sustainable adaptation (Gollier & Treich, 2003). On the other hand, history delivers good examples as to how politics can be a determining factor in responding to climate change. The adaptive capacity of the people in Vietnam was largely altered with the decision to transform the Marxist economy into a market economy (Adger, 1999). In recent times, the US states Texas and Puerto Rico (2017) exemplify the power of politics in determining the level of government investment in recovery from the impacts of hurricanes (Cinner et al., 2018, p. 120). Adger (2006) highlights socio-political stress as one type of exposure that a system must undergo, in addition to environmental pressures. Many scholars acknowledge that people's adaptive capacity is largely governed by political factors (Vincent, 2007). Fussler and Klein (2006) specifically acknowledge politics as one of the major non-climatic factors that affect exposure, sensitivity, and adaptation of systems. Taken together, this reveals the criticality of encompassing the breadth and width of politics in the purview of sustainability, and the due recognition of politics in the modified SLA framework. With reference to developing countries like Sri Lanka where political opportunism is exercised at an extreme level, many commentators (Gunasekara, 2020; Jayasuriya, 2019; Miap, 2018; NAFSO, 2012) stress the need to encompass politics in climate deliberations. Having considered the arguments of DFID (1999), McLeod (2001) and the aforementioned scholars, I argue that it is better to use the term "socio-political capital" than "social capital", as the former is more reflective of the intrinsic criticality of both social and political factors in determining the extent of sustainable livelihood that can be achieved.

The SLA framework further elaborates the behaviour of these capitals in the vulnerability and policy contexts within which they operate. In SLA, the term "vulnerability context" refers to the internal and external pressures that have the potential to threaten or damage environment that they live in. These are summarised in three main categories of phenomena: shocks; trends; and seasonality (DFID, 1999, p. 15). In other words, the vulnerability context here is limited to internal and external exposures, whereas overall vulnerability is an amalgamation of three main components: exposure, sensitivity, and adaptive capacity (IPCC, 2007). Although vulnerability with specific reference to climate

variability and change are not fully covered in the framework, a large part of it is discussed under livelihood capitals, IPPS, and livelihood strategies. For instance, livelihood capitals, strategies, and IPPs determine the sensitivity of households and communities to climate change impacts (Islam et al., 2014). Human capital, a determining factor of vulnerability, is largely shaped by the health of people in the household. This is discussed under the category of livelihood capitals (Becker, 2007). Consequently, access to clean water—which largely determines the health of households, especially in the event of a disaster—is equally important in households' vulnerability and is part of the Institutions, Policies, and Processes (IPPs) (Tandukar, 2012). In addition, skilled and educated households have more opportunities than less skilled and less educated households, thus the economic condition of the more privileged is more stable than that of the less privileged (Chanda, 2011; Cutter et al., 2003). Also, financial capital including income, savings, loans, assets, and insurance (Buckle, 2006) is crucial for vulnerable households to both survive and recover from disasters which can require a large amount of capital (Madhuri et al., 2014). In the absence of institutional credit, they often are left to acquire expensive sources of credit, such as from private money lenders, even though they first enquire about such possibilities within their social network, that is, relatives, friends, and cooperative societies to which they belong (Adger, 2003). Failing these external sources of credit, households look for other available options, for example selling or pawning livelihood assets such as their land, jewellery, TVs, and other assets. All these responses impact in turn on their sensitivity and adaptive capacity, thus their vulnerability.

The element of Institutions, Policies, and Processes (IPPs) in SLA encompasses legislation, policies, governance, formal and informal institutions, markets, and social relations (Islam et al., 2014). As shown in Figure 2.1, access is “the opportunity in practice to use a resource or service or to obtain information, material, technology, employment, food or income” (Chambers & Conway, 1992, p. 8). Accordingly, Ashley et al. (2008) claim the importance of reviewing the policy and institutional context within which the five capitals operate and function. Livelihood capitals are then analysed together with the vulnerability context, and institutional and policy settings to derive livelihood strategies which are defined as the choices and activities that contribute to household survival and to the improvement of the livelihood itself (DFID, 1999; Ellis, 2000b). The outcome of these strategies will subsequently enhance capitals and IPPs and lessen livelihood

vulnerability of communities to stressors (Morse et al., 2009) directing them towards sustainability. For these reasons, vulnerability and sustainability are both important phenomena in livelihood vulnerability assessments. Careful, holistic consideration of elements related to vulnerability and sustainability is required (Islam et al., 2014). Livelihood capitals in particular are important in assessment of vulnerabilities of systems (Reid & Vogel, 2006; Yohe & Tole, 2002). Therefore, the project supported by United States Agency for International Development (USAID) incorporates these capital aspects into its model (Household Livelihood Security Assessments – A Toolkit for Practitioners) for understanding and minimising vulnerability. Scholars also largely adopt the livelihood approach as a tool to understand the dynamics of rural societies with special reference to people (Ellis & Allison 2004), demonstrating how this approach can influence development policies (Solesbury, 2003). Overall, the importance of incorporating aspects of both vulnerability and sustainability in vulnerability assessments is clearly recognised in the literature, particularly the elements of livelihood capitals in order to advocate policies and minimise people's vulnerabilities.

2.7 Vulnerability Assessments (VAs)

Climate related vulnerability assessments are often conducted to inform development policies that address climate associated risks (Fussel & Klein, 2006; Klein & Nicholls, 1999). However, climatic and non-climatic factors, including the contexts within which they operate, are deemed important for understanding and taking action to address the vulnerabilities of a system (Fussel & Klein, 2006; Rahman, 2014). Vulnerability studies of climate change are usually conducted in a variety of contexts, depending on the required outcome for different interest groups, to understand the challenges it brings to societies and the natural environment (Eakin & Luers, 2006). As Cutter (2003) argues, in order to discuss vulnerabilities of societies, it is essential to identify and understand the sources that increase or decrease vulnerability at all scales. Vulnerability assessments in particular play a crucial role in this regard. Fussel and Klein (2006) categorise these purposes of vulnerability assessments into four main groups: (1) to identify vulnerable sectors and regions and prioritise political and research efforts; (2) to contribute to the scientific knowledge of impacts of climate change on climate sensitive systems; (3) to inform mitigation to set its targets; and (4) to facilitate adaptation measures to minimise impacts of climate change (Fussel & Klein, 2006, p. 324).

Subsequently, this yields three main decision contexts that prioritise mitigation, resource allocation, and adaptation measures. Clarifying them further, Fussel and Klein (2006) subsume these decision contexts into four main types of climate change vulnerability assessments where the scenarios of adaptation mark the difference between their evolution. They are: impact assessment; vulnerability assessment (first and second generations); and adaptation policy assessment. Impact assessment does not explicitly address adaptation but does address mitigation, while first-generation vulnerability assessments consider potential adaptation. The transition of potential adaptation to feasible or viable adaptation then distinguishes the first- and second-generation vulnerability. Thus, adaptive capacity is included in the latter. Finally, the adaptation policy assessment takes a further step towards enhancing adaptive capacity while prioritizing developing and implementing policies (Fussel & Klein, 2006). This supports Klein and Nicholls' (1999) demonstration of the importance of integrating adaptation scenarios together with impacts into VAs.

Despite this classification, by its very nature, vulnerability assessment is a process that evaluates susceptibility of units and systems at risk to various hazards in place and identify and understand the root causes of risk and determine its outcome (Downing et al., 2001; Luers, 2005; Momtaz & Asaduzzaman, 2018). As such, the process attempts to reveal the contribution of geographical, physical, social, economic, political, and psychological factors that make some people particularly vulnerable to hazards of concern, while others are relatively protected from the same type of hazards.

Therefore, vulnerability assessments are thorough investigations of human environment systems and their interactions (Adger, 2006) inclusive of all aspects of biophysical, cognitive, and social attributes of the respective system (Polsky et al., 2007). Equally, the most appropriate vulnerability assessments are also determined by: the research questions asked; characteristics of the threat; the spatial and temporal scale of the interest (Cutter, 1996); the degree of certainty of future climate projections; respective existing knowledge; and availability of resources including data (Klein & Nicholls, 1999) and expertise (Brooks et al., 2005; Fussel & Klein, 2006; O'Brien et al., 2004). The methodology for assessing vulnerability of coastal areas to sea level rise and technical guidelines for assessing climate change impacts and adaptation developed by the IPCC reflect these deeds (Klein & Nicholls, 1999).

In addition, O'Brien et al. (2004) argue for the importance of context specific vulnerability assessments, while Fussler and Klein (2006), Cutter (1996, 2003), and Cutter et al. (2003) argue that local studies that cover both geography and political ecology are critical to understand socioeconomic vulnerabilities. Klein and Nicholls (1999) underscore the importance of encompassing both anticipated impacts and available adaptation options in vulnerability assessment. Lavell (1999) also emphasises the importance of assessing and identifying the existing vulnerability of communities in terms of their socioeconomic and political structures in order to adapt effectively to the impact of concern. Likewise, Hoddinott and Quisumbing (2003) summarise these prospects of VAs into five main questions:

- i) What is the extent of vulnerability?;
- ii) Who is vulnerable?;
- iii) What are the sources of vulnerability?;
- iv) How do households respond to shocks? and
- v) What gaps exist between risks and risk management mechanisms?. (p. 46)

As argued by Bohle et al. (1994), vulnerability studies that assess current climate variability and adaptive capacity to such impacts assist adaptation science, because they reveal the ability of a system to face future circumstances of such events.

However, vulnerability assessments face several barriers. One of the major impediments is a lack of the information required to undertake the analysis (Brooks et al., 2005; Klein & Nicholls, 1999; O'Brien et al. 2004). This tends to result in the choice of inconsistent, biased, and contradictory variables (Birkmann, 2007) which ultimately lead to fallacious and invalid conceptualization of the subject of vulnerability (Fekete, 2009). On the other hand, the absence or limited availability of information on the vulnerability of systems can hamper authorities' ability to work on proactive measures (Orencio & Fujii, 2013). This in turn rationalises the essentiality of VAs in addressing climate related risks. Owing to those complexities, it is usually difficult to decide upon the most suitable methodological approach for VAs (Polsky et al., 2007). Nonetheless, Moret (2014, p. 34) states that the demands of VAs can be met through integration of concepts, full use of secondary data, and application of mixed methods, with careful consideration of the need to maintain their integrity. More importantly, Adger (2006) and Moret (2014) stress that VAs must abide by robust and credible theoretical or conceptual frameworks that engage with elements of vulnerability and explore associated risks and coping mechanisms.

The biophysical VAs conducted so far in the context of Sri Lanka reveal that climate change could bring devastating impacts to the coasts of this island nation (e.g., MENR, 2010; MENR, 2011a, 2011b; Pussella et al., 2015). The absence of VAs that examine social vulnerabilities, in particular livelihood vulnerabilities, to the impacts of climate change in coastal areas of Sri Lanka, clearly disclose the need for a study of the kind which this research provides. The subject of perception, which largely contributes to people's decisions and actions, is overlooked in many vulnerability studies (Grothmann & Patt, 2005) and in particular in Sri Lanka. There does not seem to be any record of previous studies that examine the role of perception of climate change impacts on coastal livelihood vulnerabilities and associated adaptation strategies in Sri Lanka. This study, therefore, will be the first attempt to address this research gap. Its findings will assist policy makers in the practical realm as well as scientists in the theoretical realm. Furthermore, this study considers the concepts of perception, attitude, knowledge, understanding, and awareness, holistically in many cases. These concepts are often considered separately, however authors such as Bahamonde–Birke et al. (2015) support an integrated, holistic approach.

However, assessing vulnerability of a system is complex and difficult (Cutter et al. 2003; Eakin & Luers, 2006) owing to multidimensional attributes of both the phenomenon itself and the context within which it operates. In other words, the concept of vulnerability has different facets, while coastal livelihoods are shaped and governed by various and numerous social, economic, cultural, political, and environmental factors that are often intertwined, within which “climate” has a role. This makes the measurement of livelihood vulnerability a challenging process (Raihan et al., 2010; IPCC, 2007). Therefore, it is difficult to develop a single metric to quantify vulnerability (Cutter & Emrich, 2006). For those reasons, VAs are usually guided by several approaches, and the index approach is one of the most popular and prevalent methods. Moret (2014) and Fussel (2010) provide a brief review on vulnerability assessment methodologies and indexes.

2.7.1 Index Approach

The emergence of indexes as policy tools dates back to the 1920s with the pioneer work of Edgeworth (1925) and Fisher (1922) (as cited in Sullivan, 2002). This method combines several indicators that are utilised as proxies and organised in a logical manner to form an index to determine the level of intended measurement (e.g., vulnerability) of

the systems of concern (Fussel, 2009; Hahn et al., 2009). Such an index therefore allows a great many variables to be incorporated into one comprehensive and realistic model (Hahn et al., 2009, p. 75). Such indexes can be context-specific: at global, national, regional, or even lower levels such as villages or communities (Fussel, 2009). Abuodha and Woodroffe (2006) describe indexes as rapid and consistent means of characterising varied vulnerabilities in different coastal settings. At present, a vast number of indexes are applied by various agencies to measure a number of concepts, such as poverty, sustainability, and livelihood vulnerability (Hahn et al., 2009; Shah et al., 2013; Sullivan, 2002).

The Livelihood Vulnerability Index model adopted here was formulated and field-tested by Hahn and his colleagues in Mozambique (Hahn et al., 2009) and has been applied ever since by many scholars in various settings (e.g., Adu et al., 2018; Madhuri et al., 2014; Shah et al., 2013; Tjoe, 2016). Overall, the LVI offers numerous benefits despite a few limitations such as its tendency to oversimplify the complex realities through adaptation of a few indicators and the involvement of normative judgements in selecting indicators as well as their directions (Vincent, 2007). For example, to decide whether a large segment of female-headed households increases or decreases vulnerability is a type of normative judgement since it could be argued in favour of both sides (Hahn et al., 2009). Another drawback is that the LVI masks the effect of outliers since the index is constructed on average values. Non-availability of required data at various scales is also considered a constraint in vulnerability assessments in general (Luers et al., 2003; Fussel 2009). However, as argued by Hahn et al. (2009), many of these limitations can be dealt with by employing measures like refinement, validation, and standardisation of new methodologies. Besides, Vincent (2007) claims that carefully selected quantitative indicators have construct validity and can capture variation and are broad enough to be transferable. Similarly, Clarke (2008) claims that theoretically based indicators have the power to capture the progress of set goals, and thereby to protect the successful outcomes already achieved whilst informing future practices.

I adopt the LVI model of Hahn et al. (2009) in this study, with context-specific modifications because of a number of benefits that it grants, and because the aforementioned limitations can be minimised. The benefits are outlined as follows. First, it addresses the need for a simple method to assess livelihood vulnerabilities of local

communities. Climate models often fail in communities with limited resources in remote locations, while VAs of this type are more suitable (Hahn et al., 2009). In particular, its simplicity both in terms of formulation and calculation facilitates the application of LVI among many users. Secondly, the model follows the IPCC working definition of vulnerability which conceptualises it as being constituted by three main dimensions: exposure, sensitivity, and adaptive capacity (2001). Many other scholars theorise vulnerability in a similar manner. Therefore, in this study the indicators of LVI are also organised around these three components in relation to coastal livelihoods. Thirdly, it accords with current best practice by adopting the sustainable livelihoods focus to examine the dimensions of both vulnerability and adaptation (Simane et al., 2016). Thus, LVI encompasses the factors relating to natural, human, financial, physical, and socio-political capitals which shape the behaviour of rural communities (IPCC, 2007).

Fourthly, in line with Cutter (2003) and Hahn et al. (2009) it addresses a need of policy makers and practitioners by developing a set of metrics such as indicators and indexes to estimate and compare relative vulnerabilities. In addition, the visual representation of the index enables its users to rapidly understand the contributing factors of vulnerability, unlike data presented in a tabulated form (Hahn et al., 2009). Fifthly, the sectoral vulnerability scores of LVI assist to identify the point of interventions to combat potential impacts of climate change (Eakin & Bojorquez-Tapia, 2008). The IPCC framework calculation of the LVI enables the understanding of transformation of livelihood vulnerability of the same community over time. Sixthly, it has the flexibility to incorporate context-specific indicators. This is not permitted by some other assessments (e.g., O'Brien et al., 2004; Eakin & Bojorquez-Tapia, 2008) but is considered one of its advantages.

Despite focusing on climate projections, the LVI approach assesses the strength of the prevailing social conditions to withstand the pressures generated by climate and nature-related stresses while it also appreciates the competency of intended systems to adjust (Hahn et al., 2009), the seventh benefit this study realised by its application. Overall, LVI is considered a timely pragmatic approach to understanding differential vulnerabilities in local settings (Hahn et al., 2009).

The original model of LVI of Hahn et al. (2009) comprised seven major components (socio demographic characteristics, livelihood strategies, social networks, health, food, water, and natural disasters and climate variability) with each of them containing several

subcomponents reflective of and relevant to the livelihood vulnerability context they examined. In this study, some of the indicators included in the original model are omitted while some others are added to address context specific measures. This is permitted by Hahn et al.'s model (2009), thus increasing its usability, as indexes become more usable and useful when they have the flexibility to incorporate context-specific variables (Eakin & Bojorquez-Tapia, 2008; Hahn et al., 2009; Shah & Rivera, 2007).

The following section attempts to approach a conceptual framework that facilitates the overall research objective. That is, to identify the degree of livelihood vulnerability and the scale of perception of five coastal villages, together with underlying context of specific causes and adaptation practices in place in order to support their combat with climate change, weather, and nature related stresses. Chapter Five further illustrates index construction and computation along with its results.

2.8 The Scale of Perception

A review of the climate change literature reveals that recent climate research neglects communities' "perception" into the situations of the very people who have experienced its impacts (Ayanlade et al., 2017). In particular, vulnerability studies exclude local perceptions which define some aspects of community wellbeing, such as sense of belonging, feeling of security, respect, equality, and ability to administer one's own destiny (O'Brien et al., 2004). Besides, the advancement of scientific knowledge of climate change is not adequately reflected in the awareness or knowledge of the general public. The general public, including coastal communities, possess a low level of concern about the phenomenon of climate change (Kuruppu & Liverman, 2011) which can be explained through the cognitive variable of perception (Weber, 2010).

There are various opinions about climate change among different stakeholders (Baggett et al., 2006; Hulme, 2009), some of which are attributed to perception (Weber, 2010) while others can be political, strategic (Hoggan, 2009), or cultural (Weber, 2010). The US National Research Council Committee recognises that people's perceptions about global concepts like climate change can both create and solve environmental problems (NRC, 1992, 1997). Therefore, knowledge of the sociological, cultural, and psychological factors that govern variation in perceptions, in addition to the different dimensions of perceptions

(Krause–Steger & Roski, 2014), can be of great assistance to climate-related policy interventions through convergence of beliefs and willingness to act (Weber, 2010, p. 332).

More importantly, the perception of communities predominantly shapes their coping strategies and adaptation mechanisms (Abid et al., 2015; Leiserowitz, 2007; Li et al., 2013) and influences their environmental decisions (Weber, 2010). The success of planned adaptations is also determined by local perception of climate change risks (Zahran et al., 2006). It determines how local communities define their future climate-related risks (Baron & Petersen, 2015). Thus, it is crucial to incorporate and appraise the perception by communities in climate change-related vulnerability research and understand the factors that govern it. In this way, the desired changes can be initiated in social and cultural systems. This approach is difficult and strenuous, yet it can generate the most lasting consequences (Weber, 2010).

Based on the seminal work of many scholars e.g., Baker 1991; Burton et al., 1993; Dow & Cutter 1998, 2000, 2002; Palm & Hodgson 1992; Palm 1994, Cutter (2003, p. 8) argues that although perception is not a novel subject in the study of climate change impacts), it has been neglected in the recent past (Grothmann & Patt, 2005). Even though the trend is promising with a few studies attempting to acknowledge the role of perception in climate change-related behaviours (Grothmann & Patt, 2005; Kuruppu & Liverman, 2011; Petheram et al., 2010), they still take little notice of coastal livelihoods. Sri Lanka in particular has never encompassed human cognition or perception in its climate-related vulnerability studies, thus there is a need to do so. As in many studies, perception here also refers to the concepts of attitude, knowledge, understanding, and awareness (Bahamonde-Birke et al., 2015).

Accordingly, this review now attempts to address the second objective of the research: to discover the scale and role of perception of coastal livelihoods in relation to climate change impacts and associated vulnerabilities and adaptation measures in Chilaw DS of Sri Lanka. Thus, the factors that account for variations in perceptions, together with their contextual dimensions and determinants that can be used to motivate action are discoursed. Descriptive statistics, a five-point Likert Scale, perception indexes, and qualitative interviews including FGDs with selected cases were employed as analytical tools. Accordingly, the remainder of the chapter discusses literature related to perception vs statistical description; perception and its associated decisions and behaviours; the role

of perception in vulnerability and adaptation; arriving at a conceptual model to discuss perception within a major study; construction of scales in relation to perception; and finally, the contextual revelation that understands the role of perception in climate-related vulnerability studies.

2.8.1 Perception vs Statistical Description

The average citizen often exhibits interest in weather rather than the climate, which is a statistical phenomenon (Weber, 1997; Wildavsky, 1982; Baron & Petersen, 2015). A study conducted by Reynolds et al. (2010) in the USA found that it is difficult for many laypeople to understand the difference between weather and climate. These findings are reaffirmed by Kuruppu and Liverman (2011) who conducted a similar study in the developing island nation Kiribati, and by Lorenzoni et al. (2005) with their study was based in the developed UK. Likewise, Hasan and Nursey-Bray (2018) claimed that their respondents in Bangladesh were unaware of the science or physical process that causes climate change. In fact, their perception of climate change was linked to local knowledge, experience, value, and faith (Baron & Petersen, 2015) and differed from scientific explanation (Hasan & Nursey-Bray, 2018; Kuruppu & Liverman, 2011).

From a different perspective, some scholars argue that the claims of climate scientists are based on statistical description. Weber (2010) pointed out that a statistical phenomenon like climate change cannot be accurately understood and predicted just by observation and the reasoning capacity of the general public. Also, historical memories can be flawed and predominantly driven by people's beliefs and expectations (Weber, 1997; Wildavsky, 1982). These differences in the learning processes among other things construct different perceptions (Weber, 1997). This variation in perceptions was clearly evident in research conducted by the Pew Research Centre which revealed just 49% of the general public agreed with the statement "global warming is happening largely owing to human activity", whereas the reported percentage of scientists who agreed with the same statement was 84% (Pew Research Centre [PRC], 2009a).

Weber (2010, p. 333) distinguishes the processing of information associated with personal experience as associative and affect driven. Associative processing is a natural human capacity that turns associated experience into feelings, such as fear or anxiety, according to the effect of the experience (Loewenstein et al., 2001). Thus, in terms of

analysis, associative processing is automatic and quick. In contrast to that, scientists process their information analytically, using algorithms and rules. Therefore, their processing is slow and requires cognitive effort (Weber, 2010, p. 333).

However, studies conducted by Musinguzi et al. (2016) and Ayanlade et al. (2017) conclude that farmers' perception of climate change corresponded with the scientific findings of their meteorological analysis. These claims are similar to those of Howe and Leiserowitz (2013), who recognise the ability of climate-sensitive, resource-dependent communities to perceive the changes in their local climate. In other words, people's perception can mirror the climate change trends identified by scientific data, in this case meteorological data. Thus, the usability of the perception of local communities as a tool, especially in the absence of scientific information on weather and climate, is important.

Irrespective of the degree to which scientific data may complement community members' perceptions, when they are given a choice to pay attention to information generated by personal experience and to statistical analysis, people tend to pay attention to the former. Thus, in the community, knowledge derived from personal experience tends to dominate information derived from scientific or statistical analysis (Erev & Barron, 2005). According to Weber (2010), this could be a result of the cognitive power that is required to analyse and understand scientific information. However, Finucane (2009) argues that leaving statistical phenomena like climate change solely to external sources—in this case to experts who create awareness, beliefs, and spread knowledge—is not realistic. As a matter of fact, it provokes two important matters: attention and trust. Attention is understood as a very scarce cognitive resource available for issues such as climate change where people have many other affairs to attend to, for example economic survival and household predicaments (Weber, 2010, p. 334). Trust, on the other hand, determines the extent to which people incorporate information from external sources into their decisions and actions. In other words, people pay attention to information on climate variability if it comes from a trusted source (NRC, 1999; Slovic, 1997). Nevertheless, this factual information inevitably blends with social, institutional, and cultural processes to generate variations in perception of climate change (Finucane, 2009).

In all, learning about climate change through either personal experience (Ingold, 2007; Finucane, 2009; Baron & Petersen, 2015) or statistical description (scientific data) predominantly influences people's perception of climate change (Weber, 2010). It is

essential for policymakers to realise that the way in which the general public perceives and conceptualises climate change risks differs from that of experts (Krause-Steger & Roski, 2014; Leiserowitz, 2007). As Lorenzoni et al. (2007) and Finucane (2009) aptly describe, risk assessments carried out by scientific communities alone are not capable of developing successful and effective long-term development policies. This is reaffirmed by the findings of Hasan and Nursey-Bray (2018) who claim the importance of incorporating value judgements, societal and individual perceptions in policy-related climate change risk studies, particularly the ones carried out in developing countries. Adding to this, Clarke et al. (2013) aptly describe several factors encompassing the significant role of cognitive and psychological aspects that are relevant to coastal governance. Graham (1994), and Kasperson and Kasperson (1996) claim that the power of the public—in particular their attitudes, values, understanding, experience, interest, and even political affiliation—ultimately determines and prioritises responses to environmental issues, rather than the knowledge of scientists. Similarly, Buys et al. (2012) argue that knowledge generated through statistical description should be conveyed to communities, for they can then make informed decisions which in turn assist implementation of adaptation measures.

Therefore, it is important and essential to address both of these avenues, perception and statistical description that are responsible for varied perceptions, rather than leaving the subject of climate change solely to scientists and associated scientific analysis. Together these two mechanisms will help to mould the perception of people in desired ways to generate needed outcomes, primarily changes in human behaviours.

2.8.2 Perceptions, Decisions, and Behaviours

Perception, in particular risk perception, is a subject of several disciplines, including cultural psychology, anthropology, sociology, geography, political science, and behavioural economics (Slovic, 1987). Likewise, a great number of studies outside of climate change claim the influence that motivation and perceived abilities have on human action (Grothmann & Patt, 2005). Arbuckle et al. (2015) assert many behavioural models, such as the expectancy value model, values–beliefs–norms theory, and the theory of planned behaviour, are all premised upon a person’s risk perceptions and beliefs. In simple terms, perceptions can be turned into decisions and then associated actions. McAlister et al. (2008) define behaviour as “a product of an individual’s learning history, present perceptions of the environment, and intellectual and physical capacities. Thus, behaviour

can be changed through new learning experiences, guidance in the adjustment of perceptions, and support for the development of capacities” (p. 177). This signifies the role of perception in climate science which demands change in human behaviour in relation to mitigation and adaptation.

The phenomenon of perception primarily explores people’s understanding, awareness, attitudes, and policy preferences towards a particular hazard or a threat (Leiserowitz, 2007; Whitmarsh, 2008). Different people perceive their environment and associated risks differently (Hasan & Nursey–Bray, 2018; Howe & Leiserowitz 2013) depending on their ability (Dong et al., 2018), interests, experiences, and information available about a disaster (Messner & Meyer, 2006). As Milton (1996) states, “whatever people hold in their minds forms a basis for their actions, which, through being observed and interpreted, feed back into their consciousness, reinforcing and modifying their understanding of the world” (p. 18).

These arguments reiterate the importance of encompassing the subject of perception in vulnerability and adaptation science of climate change as it highlights its role in human decisions and actions. It is also acknowledged that decision-making or problem-solving processes evolve with several other factors with which individuals are associated, such as power relations and political affiliations (Bachrach & Baratz, 1962). The scholars discovered the significance of analysing individual’s decision-making processes from a psychological point of view. Further, peculiar decisions—such as to neglect highly probable events while concentrating on less likely events in relation to adaptation (Crocker, 1981—disclose the importance of examining cognitive aspects, such as perception in the process of decision making, so that others can intervene to assist the process (Grothmann & Patt, 2005).

Many scholars argue that perceptions are subjected to socio-demographic factors, economic status, and attributes of risks (Armas, 2006; Opiyo et al., 2016). For all those reasons, the same living environment can be considered dangerous by some people while for others it is relatively safe (Crocker, 1981; Weber, 2010). This justifies the different strategies that reside in a society and different behaviours which show up during disastrous events (Dong et al., 2018). Earlier, Slovic and Peters (2006) identified two principal ways in which people perceive and act on risk: risk as feelings and risk as analysis. As they described, risk as feelings refers to our instinctive and intuitive reactions to

danger. Risk as analysis “brings logic, reason, and scientific deliberation to bear on risk assessment and decision making” (Slovic & Peters, 2006, p. 1). However, Weber (2010) outlines and provides evidence that the environmental decisions of communities are influenced by three main processes: affect-based; analysis-based; and rule-based.

The affect-based group is associated with exposure to risk that accounts for varied experiences of people which eventually govern their perception of risk (Keller et al., 2006). Accordingly, the degree or severity of experience of the consequence determines the level of risk perception. In this case, these two variables have a direct relationship where when one increases, the other one increases simultaneously. Thus, the association of slow onset impacts of climate change can lower the perception of risk by communities towards the prospects of climate change unless they are accompanied by an extreme and dreadful experience (Weber, 2010).

This argument is also supported by Baan and Klijn (2004), who claim that disaster preparations are positively impacted by the emotion of fear. However, in contrast, McPherson and Saarinen (1977) argue that although householders’ negative experiences during a disaster can shape their attitude and behaviour towards similar future disasters, these constructed perceptions are more apathetic and passive, thus requiring less effort to recover and regain the previous status. Nonetheless, climate change expressed as an instantaneous phenomenon is likely to generate more fear among people than when it is expressed as a gradual process (Weber, 2010). To an extent, this explains why people continue living in hazard zones despite their awareness of the consequences. According to Weber (2010), such decisions are also affected by status quo biases or change inertia.

The analysis-based group explains how the risk of perception differs based on people’s analysis. People usually regard climate change as a geographically distant future event with uncertain risks. So, they tend to discount the possible consequences of the phenomenon (Weber, 2010). Trope and Liberman (2003) attribute this type of risk perception and associated decisions to consequences of events and their time of occurrence. Accordingly, people interpret events closer in time in concrete terms while the distant future events are construed in abstract terms. For instance, the way people apprehend a hurricane passing tomorrow (in concrete terms) is different to the way they apprehend predicted coastal flooding in 40 years from now (in abstract terms). Consequently, people are afraid of events related to concrete terms but not of events

associated with the remote future (Weber, 2010). From a different perspective, the events that produce negative effects and their understanding as concrete terms can steer ecologically damaging consumption behaviours (Weber, 2010).

According to the last group who adhere to the rule-based process, environmental decisions are influenced by the rules which exist in social ecological systems either as laws, social norms, or self-imposed admonishments (Prelec & Herrnstein, 1991). In this regard, the social roles of decision makers are of vital importance due to inherited responsibilities in such roles as parents, teachers, or Christians. Human development is largely attributed to observational learning and imitation (Meltzoff & Moore, 1999) because the influential role models and decision makers construct implicit rules and role-related obligations (Weber, 2010). Thus, peer modelling can be successfully employed as a method to influence human behaviour (Schunk, 1987). In addition, Dong et al. (2018) argue that the existence of reciprocity between neighbours' influences on one another's perception of the environment steers coevolution of environmental perceptions and cooperative behaviours, in particular during events like evacuation.

This act of cooperation exists in both the natural environment and human society, which facilitates coevolution between environmental perception and cooperative behaviour that in turn generates great power. For instance, teams can achieve goals that an individual alone cannot (Dong et al., 2018). This degree of cooperation is highly influenced by the situation or condition of the environment, whether it is safe or dangerous. The former will decrease the degree of cooperation while the latter will increase it (Dong et al., 2018).

Although this categorisation indicates ways in which human decisions can be influenced and manipulated, there is a risk that such approaches can generate unanticipated consequences. It is important to be aware of this. In particular, increasing anxiety about one genre of risk can lower the level of people's concern about another type of risk (Weber, 2006). For example, the increased concern about financial issues at the time of the Global Financial Crisis reduced the level of worry people had about climate change and environmental degradation (PRC, 2009b). This is because worry is a finite resource which people are not equipped to exercise in relation to all the problems they face at once (Weber, 2006, 2010). In a different argument, Kuruppu and Liverman (2011) claim that people's perceived risk is fundamentally guided by several factors: facts of exposure; the

extent to which people cognise the aspects of risk; how visible the risk is for them; and how capable they are of controlling the risk.

Further, Weber (2010) argues that people take action to lower risks about which they are anxious but are usually reluctant to take further actions to gain incremental protection or risk reduction, because the action already taken relegates the feeling of worry to the level where they are satisfied. These single actions are not necessarily the most constructive and rational ones and vary depending on the person (Weber, 2010). Therefore, she argues that the behavioural research that attempts to understand this complexity in decision making emphasises the significance of mediation with attention-catching and emotionally engaging information to address the phenomenon of climate change. This of course should be done with great caution about the unintentional circumstances of such interventions while giving attention to overcoming the cognitive barriers of the people (Weber, 2010). This highlights the importance of understanding the facets of perception and its governing factors.

With regard to perception and associated coping mechanisms and adaptation strategies, the study conducted by Madhuri et al. (2014) revealed that implementation measures to address a flood situation were not successful owing to the negligent attitude of the particular affected community. It is clear that perception creates the gap between a household's applied and available capacity during a disaster. Fatalistic and impassive attitudes can also prevent households from adapting resilience measures (Madhuri et al., 2014). Similarly, Coles (2005) states that despite the scarcity of water in Eastern Sudan, people's consumption of water is still dependent upon their perceptions, and the extent to which they chase their economic goals. Such evidence shows that it is imperative that policy makers understand and appreciate local perceptions and preferences related to proposed policy schemes on adaptation to minimise the realised vulnerabilities (Leiserowitz, 2007; Patt & Schroter, 2008).

2.8.3 The role of Perception in Vulnerability and Adaptation

The subject of perception is an integral part of climate change research and vulnerability assessments due to its capacity to guide adaptation policies and ability to reduce vulnerability and associated costs (Grothmann & Patt, 2005; Smit & Pilifosova, 2001). Narayan (2005) emphasises the importance of encompassing the aspects of

psychological dimensions in definitions of adaptive capacity, a process which she believes is often neglected. Her argument is premised on the ability of such aspects as efficacy beliefs to guide human behaviour. Likewise, Hughes (2006) (as cited in Kuruppu and Liverman, 2011) states that motivation for anticipatory adaptation can only be acquired through an intellectual process, because people need to think, understand, and relate to such concepts before initiating an action. In particular, studying the context-specific perceptions of climate change is of vital importance to understanding how local communities respond to it (Tschakert, 2007). Adaptation is one of the most prominent solutions to climate change impact-associated vulnerabilities and relies on the adjustment of human behaviour. Perceptions of communities largely determine the process of adaptation (Adger et al., 2009), because the perceived risk can be different to actual risk (Grothmann & Patt, 2005).

Regardless of their importance in vulnerability and adaptation science, the assessable and adjustable psychological factors are largely neglected in recent climate change-related vulnerability studies. Consequently, the limited empirical literature on science behind the decision-making process of adaptation often misinterprets financial, technical, and institutional factors as major constraints to adaptive capacity. Only a few studies reveal the significance of perception (Grothmann & Patt, 2005). For example, Weber (1997) asserts that the adaptation of US farmers was guided by perception and expectation, while Maddison (2007) claims that perception is a necessary prerequisite for adaptation. However, it is not the case that these scholars deny the significance of physical constraints as such. Instead, they emphasise the importance of including psychological dimensions as well in vulnerability and adaptation science for the reason that people's "objective ability" could be very different from their "subjective ability." Additionally, it could be more important to address people's subjective ability if it is required to change their adaptation behaviours (Grothmann & Patt, 2005, p. 202).

A person's objective ability refers to availability of and accessibility to resources to take an adaptive action, while subjective ability refers to perceived aptitude of a person on available resources. In other words, the ultimate act is partly dependent upon how people interpret their objective ability. Thus, perceived adaptive capacity is different from actual adaptive capacity or objective ability Grothmann and Patt (2005). Likewise, some underestimate their scope for action while others overestimate theirs. This is referred to

in psychology as illusions of control (Wortman, 1976) and it partially explains why different people adapt differently to the same status of threat.

Despite the recent past, some studies do explore the power of cognition in adaptation in the context of both developed and developing countries, and demonstrate the role of perception in adaptation strategies to overcome perceived vulnerabilities (Kuruppu & Liverman, 2011; Petheram et al., 2010). Grothmann and Patt (2005) provide a good example of this with the introduction of the Model of Private Proactive Adaptation to Climate Change (MPPACC) that elaborates the role of perception in the process of adaptation to climate change impacts to overcome associated vulnerabilities. The model is also supported by elements that assist both vulnerability and adaptation assessments. Thus, it is usable and applicable in this study.

2.9 Conceptualising Psychological Approach in Livelihood Vulnerability and Adaptation

The main conceptual framework (see Figure 2.3) of this study is guided by a few fundamentals that theorise vulnerability and adaptation, encompassing both subjective and objective elements. This section elaborates the psychological (subjective) aspects and their particulars in the main framework. The subjective part of livelihood vulnerability is guided by the Model of Private Proactive Adaptation to Climate Change (MPPACC) of Grothmann and Patt (2005).

The model is chosen to guide the study due to its two main strengths. First, it allows the recognition of cognitive barriers that exist within households in order to overcome the vulnerabilities of climate change. It also allows researchers to find reasons why some people demonstrate adaptive behaviour while others do not. Second, it opens avenues to increase the adaptive capacity of the people and envisage future vulnerabilities and adaptation, thus assisting better preparation. In particular, if people's perceived adaptive capacity is lower than their objective adaptive capacity, it implies the existence of cognitive barriers which can in turn be addressed to develop better policy options (Grothmann & Patt, 2005). Most of the time these cognitive aspects are unnoticed and are therefore not considered in policy. There are many policies that address socioeconomic aspects only. Therefore, the findings of this type of study can inform the process of developing new policies that generate drastic impact on vulnerable communities (Grothmann & Patt, 2005).

The model of MPPACC is primarily founded upon the Protection Motivation Theory (PMT) of Rogers (1983), and Rogers and Prentice-Dunn (1997). It mainly distinguishes between two perceptual processes, “risk appraisal” and “adaptation appraisal” that ultimately decide adaptation intention and adaptation (behaviour) of an individual (Figure 1 of Grothmann and Patt, 2005, provides a detailed description). In Figure 1, risk appraisal is an outcome of the combination of two central elements: perceived probability and perceived severity. Perceived probability delineates the understanding of the extent to which people see themselves as exposed to a certain threat (or threats), while perceived severity explains the anticipated degree of damage a threat can cause to the things that they value in comparison to or relative to other priorities in their lives (Grothmann & Patt, 2005, p. 203).

Adaptation appraisal on the other hand constitutes three key components that determine the perceived adaptive capacity. They are: perceived adaptation efficacy; perceived self-efficacy; and perceived adaptation costs. The first speaks of an individual’s belief towards the ability of an adaptation action to alter the circumstances of a threat while the second describes a person’s belief in their own ability to support that adaptation action which is determined by factors such as technical skills and knowledge. The third explains the cost of perceived adaptation response. This cost can be in many forms: time, money, or effort. Even though self-efficacy and adaptation costs have overlapping similarities, Grothmann and Patt (2005) argue that it is useful to distinguish between them by giving an example of an individual who may find it difficult to adapt either due to low self-efficacy or high adaptation costs. These two processes are sequential, thus, unless the perceived risk exceeds a specific threshold, an individual will not move on to the second stage: adaptation appraisal (Grothmann & Patt, 2005; Maddison, 2007; Rippetoe & Rogers, 1987). This claim also complements the work of Schwarzer (1992) who states: “a minimum level of threat or concern must exist before people start contemplating the benefits of possible actions and ruminate their competence to actually perform them” (p. 235).

An individual then arrives at an adaptive response which is the immediate outcome of two perceptual processes steered by all those elements: avoidant maladaptation or adaptation intention (Grothmann & Patt, 2005). Maladaptation consists of three main responses: fatalism, denial, and wishful thinking. However, as argued by Grothmann and

Patt (2005), the adaptive response does not guarantee an “adaptive action”. Instead, it forms an “adaptation intention” which may or may not turn into an action depending on the circumstances of an individual. Apart from this basic process, the model also reveals internal factors that govern individual cognition and the factors that are external to cognition yet affect overall perception. Owing to simplicity and practicality, I decided to focus only on external factors in addition to the aforementioned basic process leaving the internal influences on cognition for a subsequent, detailed study.

The model makes explicit the effect of three main external factors on a person’s perception which could influence adaptation intention and action. They are: social discourse; adaptation incentives; and objective adaptive capacity. Social discourse discussed here is similar to that of the social amplification of risk demonstrated by Kasperon et al. (1988). It exemplifies the role of social, institutional, and cultural context in shaping one’s own perception and behaviour. Adaptation incentives here refer to rewards, such as tax reductions, laws, and norms which motivate adaptation. The third factor, objective adaptive capacity, which is popular in adaptation research, demonstrates the resource pool of an individual. It validates ownership of and availability of and accessibility to resources such as money, time, technical skills, knowledge, and social and institutional support. For example, objective adaptability, in light of lack of resources, can sometimes hinder this transformation from intention to action. Thus, if a programme can locate where adaptation intention occurs yet is hindered by such limitations, it could assist turning such intentions into action. This would be a profound approach in adaptation.

Based on this ability to identify at which stage of adaptation an individual stands, Kuruppu and Liverman (2011) proposed the use of the Stage of Change Model (SCM) to enhance the performance of MPPACC. Therefore, it is incorporated in the conceptual model of this study to enhance the adapted model’s usability and performance.

The Stage of Change Model pioneered by Prochaska and DiClemente (1983) demonstrates a process which consists of five successive stages that people go through when they change their behaviour: pre-contemplation; contemplation; preparation; action; and maintenance. The people at pre-contemplation stage are either unaware or not fully aware of the problem. Thus, they have no intention to take action or change their behaviour in the foreseeable future. On the other hand, a person at the contemplation stage is aware of the existence of the problem and is considering whether to take an

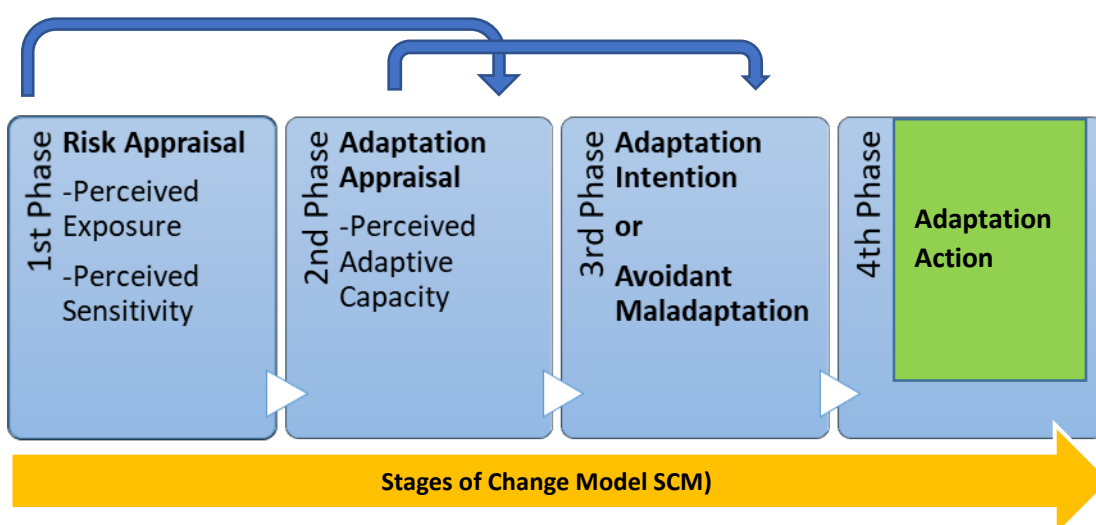
action but has not yet made a commitment to do so. People in the preparation stage intend to initiate an action and find possible ways to perform that action, whereas people in the action stage initiate the action and/or change their behaviour to overcome the problem. An individual in the final stage (maintenance) continues the changed behaviour and ensures that implemented actions are not reverted.

Accordingly, SCM can be employed to recognise these steps with respect to the process of adaptation, in particular the stage at which the transition happens, that is from intention to action. It is of the utmost importance for policy makers to understand where the target group stands, including how many people are in each stage. Consideration of these variables will significantly assist the development of customised adaptation interventions (Kuruppu & Liverman, 2011).

Taking into consideration these important aspects of MPPACC, and SCM and the three fundamentals of the IPCC (2001) definition of vulnerability, a psychological framework (see Figure 2.2) is developed to elucidate the subjective aspects of vulnerability and adaptation in its simplest form, thus making them understandable to a wider audience. The framework can be used as an entry point, particularly in a context where previous literature on livelihood vulnerability and adaptation in the purview of perception is absent.

Figure 2.2

The role of perception in vulnerability and adaptation



Note. Source: author

This framework attempts to emphasise the role of vulnerability, unlike the original model of MPACCC by Grothmann and Patt (2005). It aligns vulnerability with the IPCC definition which formulates vulnerability as a function of exposure, sensitivity, and adaptive capacity. Therefore, the perceived probability and perceived severity of MPPACC presumably address the same aspects of exposure and sensitivity, respectively. Perceived adaptive capacity, which is the outcome of the adaptation appraisal, corresponds with the adaptive capacity in this vulnerability formula.

However, in their original applications, MPPACC focuses on adaptation whereas the IPCC definition centres on vulnerability, despite the fact that these two inseparable phenomena share similar elements in their assessments.

Overall, the research is organised in a way that the study of the modified Livelihood Vulnerability Index (LVI) of Hahn et al. (2009) delivers objective results whereas the modified Model of Private Proactive Adaptation to Climate Change (MPPACC) delivers subjective results of assessments of livelihood vulnerability on climate change impacts. As argued by Grothmann and Patt (2005), a person's adaptive response is a result of both subjective and objective factors relating to livelihood vulnerability and adaptation. Thus, it is important to have both subjective judgements and objective estimations to formulate a holistic view of climate change impacts on coastal livelihoods. This in turn facilitates respective policies that are developed either to reduce vulnerability or to enhance adaptation. Consequently, the modified model adapted the elements of both the IPCC definition and MPPACC, that is, it follows the terminology of IPCC within the modified framework of MPPACC (see Figure 2.2).

As shown in Figure 2.2, the whole process in the adapted framework to understand perception is divided into four phases: First phase, risk appraisal—as demonstrated by perceived exposure and perceived sensitivity; Second phase, adaptation appraisal—delivered by the components of perceived adaptive capacity; Third phase, adaptation intention or avoidant maladaptation—the immediate outcome of risk appraisal and adaptation appraisal; Fourth phase, the adaptation action. The first three phases relate to individual cognition while the fourth phase relates to individual action. In other words, the modified model simply demonstrates the cognition process and its outcome with regard to adaptation in the light of a community's vulnerability to climate change impacts. The individual here refers to the head of the household. Similar to the research of Kuruppu

and Liverman (2011), SCM is incorporated to enhance the performance of the adapted model of the study, by identifying to which stages the participants belong.

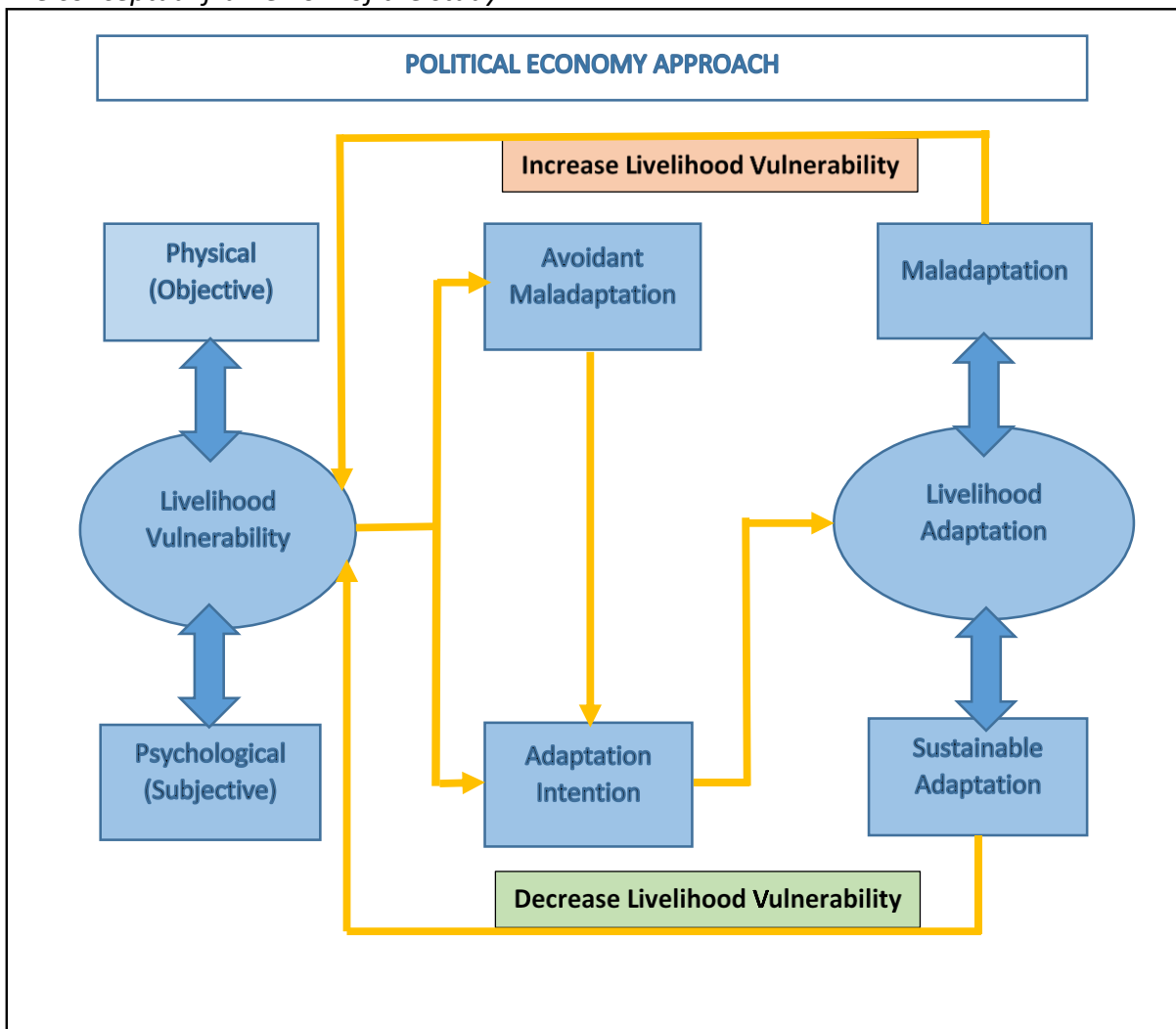
During the first two phases, an individual will make an assessment of the impacts through perceived exposure, perceived sensitivity, and perceived adaptive capacity. This assessment or appraisal can result in two main cognitive levels, “avoidant maladaptation” or “adaptation intention” which will then translate into an action depending on the ability to overcome constraints that inhibit the action which is described in the MPPACC of Grothmann and Patt (2005). Actions however can be of two types: positive and negative. Positive adaptations are the ones that sustain both the livelihoods and the resources upon which current or alternative livelihoods are constructed. The negative action is often referred to as maladaptation. These psychological perspectives and associated actions are embedded in the main conceptual framework (see Figure 2.3) that is discussed below. Within the bigger picture it elaborates how these three concepts—livelihood vulnerability, perception, and adaptation—are integrated within the purview of a political economy approach.

2.10 Conceptual Framework: The Process of Perception, Vulnerability, and Adaptation

The main conceptual framework of this study which is illustrated in Figure 2.3 draws upon the aforementioned literature encompassing the psychological approach to livelihood vulnerability and adaptation. Thus, it primarily focuses on the integrated concepts of vulnerability and adaptation while incorporating the traits of perception and sustainability. The framework exemplifies both the physical (objective) and psychological (subjective) aspects of vulnerability in order to gain a holistic view that facilitates the understanding of actions by coastal communities in combatting contemporary climate change impacts which befall their livelihoods. Thereby, this framework assists the study to comprehend climate related dimensions of vulnerabilities, associated perceptions and adaptation measures that are in place. It aims to earn the subsequent attention of policy makers to minimise the vulnerability of coastal livelihood and advocate necessary adaptation measures while contributing to the theory of vulnerability and adaptation.

Figure 2.3

The conceptual framework of the study



Note. Source: author

In sum, the prime theoretical concept addressed here is livelihood vulnerability, thus the framework starts with it. The concept of “livelihood” in this study is largely influenced by the sustainable livelihood approach, particularly its capital components, and adapts the definition of DFID (1999) from that perspective. Vulnerability on the other hand is governed by the popular 2001 definition of IPCC (2001) because of its clarity, usability, and compliance. The IPCC is a highly regarded legitimate organisation that works on climate change impacts and provides a vital resource base for scholars, thus abiding by its terminologies and precepts will facilitate inter-assessment comparisons that are crucial for the advancement of vulnerability science (Adger, 2006; Cutter, 2003; Fussel & Klein, 2006; Hahn et al., 2009).

The framework portrays two branches which emerged from livelihood vulnerability: objective or physical livelihood vulnerability, and subjective or psychological livelihood vulnerability. Physical vulnerability is formulated as the function of exposure, sensitivity, and adaptive capacity (IPCC, 2001). The Livelihood Vulnerability Index (LVI) model of Hahn et al. (2009) was administered for the calculation in that respect. The same formulation is applied to psychological vulnerability, yet termed as perceived exposure, perceived sensitivity, and perceived adaptive capacity, which has already been discussed at length in Section 2.9.

The whole process of vulnerability and adaptation in this study is viewed through the lens of a political economy approach which rationalises vulnerability as a “starting point”. In that perspective, this study aligns with the argument of Hulme (2008) who recommends that scholars interpret climate change as a cultural concept in addition to its natural science base. Adding to this, Skoglund and Jensen (2013) criticise the highly “managerial approach” of climate professionals in climate change policy development on the ground of their negligence of social action in determining response to its impacts. They recognize the failure of one-size-fits-all development approaches in addressing contemporary climate related issues which are desperately in need of case specific political reforms (Cornwall & Brock, 2005). Thus, the framework recognizes the magnitude of ideas and ideologies, power, and institutional capacity in climate policy reforms by moving beyond orthodox international political economy analyses that often depend exclusively on material aspects (Tanner & Allouche, 2011).

More importantly, the appreciation of the political economy approach in the purview of policy development allows researchers to understand the dynamics and traits that govern the adaptive capacities of people. It also provides understanding as to how the dominant narratives of communities such as the narrative of “climate change is a grave threat to humankind” (Tanner & Allouche, 2011, p. 10) should be managed. More precisely, this approach helps to clarify the ways to challenge harmful narratives or to promote healthy narratives in order to improve the policy impact (Tanner & Allouche, 2011). In this manner, a political economy perspective allows the researcher to contribute to the growing body of literature that investigates how the phenomenon of climate change is understood and translated in the daily routine of coastal communities, which in turn

determines their vulnerabilities, adaptive capacities, and respective adaptation measures (Artur & Hilhorst, 2012; Tanner & Allouche, 2011).

Treating the inter-relatedness of vulnerability and adaptation as a process as exemplified in the framework permits the researcher to break down the concepts into sequential steps which in turn provide the space to understand and evaluate the process. It allows important bottlenecks to be identified, thus facilitating intervention as needed. The constituents of physical (objective) and psychological (subjective) vulnerabilities are further explained in the respective chapters related to the livelihood vulnerability index (Chapter Five) and the scale of perception (Chapter Six), together with the results.

Finally, I would like to note that as in any conceptual model this highlights the important aspects that guide the research objectives and system under consideration at the expense of other aspects (Tanner & Allouche, 2011). Thus, this framework does not explicitly address temporal dimensions, cross-scale relationships of the elements, the level of uncertainty associated with the phenomenon itself, and elements presented in the framework. Similarly, the framework does not exhibit dynamic aspects of the setting and how the process works in a multi-actor context. Yet, it accommodates and significantly facilitates the examination of the research objectives. In line with that I utilised both types of data and combined them to best understand the research question and to address the overall purpose of the research. Miller et al. (2010) and Moret (2014) emphasise that studies that assess vulnerabilities should use hybrid methodologies that are both qualitative and quantitative in order to address the multidimensional and complex nature of the subject.

Chapter 3. Methodology

3.1 Introduction

This chapter provides an overview of the research methodology. At the outset, it discusses the philosophical foundation upon which the research scope is developed. The discussion then leads to the research approach, followed by the research design and then strategy. Subsequently, the data collection methods adopted during the research are discussed at length, including the limitations I encountered during the process. The chapter then proceeds with the description of the data analysis and the measures of validity and reliability. Finally, the ethics approach is discussed in relation to the use of a mixed methodology and case study strategy.

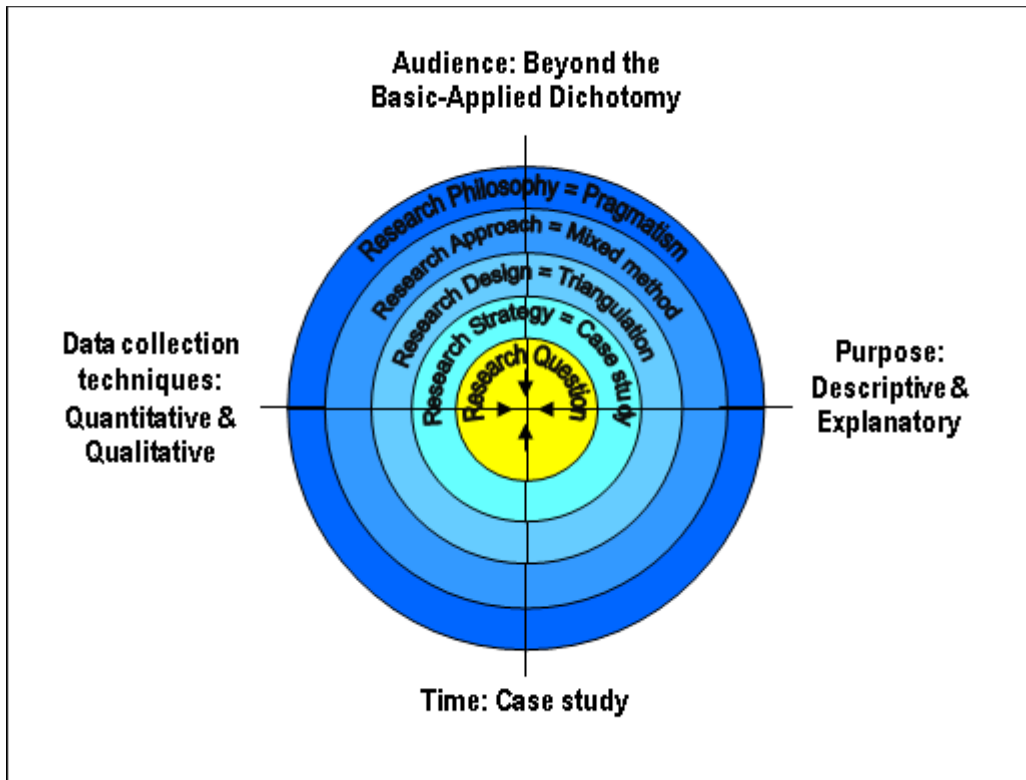
Accordingly, the methodological framework is first discussed with respect to five foundational aspects: research philosophy; research approach; research design; research dimensions; and research strategy (see Figure 3.1). Following this, the specifics of context and sample selection; data collection; data analysis; ethical consideration; and validity and reliability are presented.

In brief, the research process was based on the paradigm of methodological pragmatism. A mixed method approach was utilized to collect and analyze data from the selected five coastal *Grama Niladhari* Divisions (GNDs)² which are located between the sea and the lagoon in Chilaw, Sri Lanka. A case study strategy was employed in order to find answers to research questions that were unique to those five GNDs and their livelihoods. Tools comprised Household surveys, Knowledge, Attitude and Practice (KAP) surveys, Key Informant Interviews (KIIs), Focus Group Discussions (FGDs). In-depth face to face interviews, common to both quantitative and qualitative methods were administered. In addition, participant observation, an obtrusive observation, and searching of archival records were also utilized to validate the findings from the surveys and interviews. The main unit of the analysis was the household. To conduct the quantitative analysis, the tools SPSS 22 and MS Excel were used, and the qualitative analysis was assisted by NVivo 10. Fieldwork was carried out over a period of ten months from April 2015 until January 2016.

² GND is the lowest administrative unit of central government of Sri Lanka. It is similar to a village (MEN, 2011)

Figure 3.1

Methodological framework of the study



Note. Source: Author

3.2 Research Philosophy

Research philosophy rationalizes the methodological approach that is adopted to investigate the research question. In other words, it explains the philosophical ground on which the methodology is selected in order to generate the required results. These grounds are generally referred to either as “paradigms” or “worldviews” and are considered important in social research (Bryman, 2012; Creswell & Plano Clark, 2007). Therefore, it is crucial to understand the paradigm upon which the research is constructed, explain it beforehand, and exercise it throughout the process (Maxwell, 2005; Neuman, 2006).

Kuhn (1975) argues that a paradigm provides a foundation and a guidance to theory and research. Likewise, Guba and Lincoln (2005, pp. 191–215) assert the significance of a paradigm as it constitutes a set of assumptions and beliefs that guide research. Neuman (2006) also claims the significance of knowledge in paradigms in selecting the most appropriate research techniques. In the same way, Creswell and Plano Clark (2007) highlight the importance of awareness of the paradigm owing to its ability to inform the

inquiry. Similarly, Lynch (2013) argues that every scientific process should start with the aim of generating rigorous results, thus the importance of identifying the relevant paradigm. In other words, the understanding of how the researcher views the world is important as it determines how the data are interpreted, and thus the results (Lynch, 2013). These claims highlight two crucial points. First, every research or study is fundamentally guided by a paradigm which explains the nature of reality and knowledge. Second, identifying the respective paradigm within which the research is operative is of significance, because it suggests appropriate tools and generates rigorous results.

Nevertheless, this is only one side of the debate about the use of paradigms to determine techniques or tools in the research to produce valid results. In contrast to the arguments above, some argue that better tools and rigorous results are still possible without a deeper understanding of paradigms, but with a thorough focus on and understanding of the research question itself (Patton, 2002; Tashakkori & Teddlie, 2003). This oppositional argument holds that the research question itself can generate the most appropriate techniques to investigate and produce rigorous results (Tashakkori & Teddlie, 2003). As Patton (2002) states:

My practical (and controversial) view is that one can learn to be a good interviewer or observer, and learn to make sense of the resulting data, without first engaging in deep epistemological reflection and philosophical study. Such reflection and study can be helpful to those so inclined, but it is not a prerequisite for fieldwork. Indeed, it can be a hindrance. (p. 69)

Therefore, according to Patton (2002), trying to fit into a paradigm can confine researchers to limited methodological choices rather than allowing them the opportunity to select a number of methods to investigate the problem of interest. Leading researchers utilize certain techniques in practice which could not fit into philosophers' ideal model of science (Neuman, 2006). Despite these debates that argue two extremes—either to apply or not to apply the knowledge of paradigm—other scholars suggest a balance between both abstract philosophical stances and pragmatic circumstances in choosing a methodology.

Brannen (2005) acknowledges the difficulty of deciding a method to examine a research question that best fits with both the abstract philosophical world and the real–

world setting. Yet she highlights the importance of both. Similarly, Greene and Caracelli (2003) argue for:

the importance of context, substantive theory, practical resource constraints and opportunities, and political dimensions of social research as equally important bases for practice decisions...It is time to balance the philosophical, conceptual, practical, and political considerations so relevant to our inquiry. (p. 108)

Bryman (2012) also acknowledges the crucial role played by the research problem and its associated practical considerations when a researcher makes the decision about the appropriate methodology for the investigation. He, however, recognizes the importance of using abstract philosophical stances to make such decisions whenever and wherever possible. In his own words:

While practical considerations may seem rather mundane and uninteresting compared with the lofty realm inhabited by the philosophical debates surrounding such discussions about epistemology and ontology, they are important ones. All research is a coming together of the ideal and the feasible. (Bryman, 2012, p. 41)

However, these debates which highlight the importance of encompassing real-world situations in choosing a methodology are finally resolved by the notion of "pragmatism". Pragmatism is a problem-centred paradigm which emphasizes the consequences of the research. Thus, it allows multiple methods, providing they facilitate thorough investigation of the research question (Creswell & Plano Clark, 2007; Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2003). In addition to that, it permits singular and multiple realities and also multiple stances. In other words, pragmatism provides the space for both hypothesis testing (as in quantitative analysis) and illustrating different perspectives (as in qualitative analysis) in one platform while giving the researcher the freedom to include both biased and unbiased perspectives with regard to the question under investigation (Creswell & Plano Clark, 2007). Pragmatism rejects dogmatism (Johnson & Onwuegbuzie, 2004, p. 17), so permits the mixing of methodologies and use of mixed method approaches to investigate the research inquiry of interest.

This research examines the extent to which the livelihoods of coastal communities are vulnerable to climate change impacts, and the degree of vulnerability manifested as a result of the context within which they live and upon which their perceptions and

adaptation mechanisms are built. It could fit into both the post-positivist (Neuman, 2006) and constructivist (Creswell & Plano Clark, 2007), paradigms which often frame quantitative and qualitative research respectively. From a different perspective, it could also resonate with paradigms such as ecological psychology and phenomenology, because the former answers questions relating to interactions between environment and the people whereas the latter addresses the lived experience of a phenomenon (climate change in this case) of a particular group (Patton, 2002). However, none of these paradigms are flexible enough to allow either multiple methods or multiple stances and perspectives. Moreover, each paradigm carries assumptions that are contradictory to the assumptions in other paradigms, thus it is doubtful that they could be blended together (Ritchie et al., 2003). In fact, purists view each paradigm as ideal for the stipulated research genre but strongly oppose mixing quantitative and qualitative methodologies and their associated methods (Johnson & Onwuegbuzie, 2004). Nevertheless, the research question of this study clearly demonstrates the need for adopting a mixed method approach to answer the questions “what” and “why”. Thus, this study is fundamentally guided by the paradigm of pragmatism mainly on the grounds of its flexibility in choosing different methods, and in particular adopting a mixed method approach (Creswell & Plano Clark, 2007).

3.3 Research Approach

mixed method research is the third methodological movement (after quantitative and qualitative research) and it carries its own philosophical, theoretical, and methodological principles to inform the conduct of mixed methods (Cameron, 2011; Tashakkori & Teddlie, 2010). Johnson and Onwuegbuzie (2004) briefly define mixed method research as “the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study” (p. 17). It is defined by Creswell and Plano Clark (2007) as:

a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone. (p. 5)

Thus, the bottom line is that “the mix” should be able to generate rigorous results and the best answer to the inquiry under investigation which otherwise cannot be achieved through a single method alone (Johnson & Onwuegbuzie, 2004).

Therefore, the logic of inquiry in mixed method research contains three main elements, induction, deduction, and abduction (Johnson & Onwuegbuzie, 2004). That is, throughout the process it discovers patterns, tests hypothesis, and uncovers the best explanations to understand the research results. In a mixed method approach, the researcher collects both quantitative and qualitative data, facilitated by multiple forms of data collection techniques. It also involves various types of analysis (Creswell & Plano Clark, 2007). However, these are all guided by the research question. The use of multiple methods in seeking a better answer for the question makes mixed method research a more creative and expansive form of its kind (Johnson & Onwuegbuzie, 2004).

Creswell and Plano Clark (2007) outline four main situations where researchers use mixed methods to address research questions: first, a need exists for both quantitative and qualitative data; second, a need exists to enhance the research with a second source of data; third, a need exists to explain the quantitative results; fourth, a need exists to first explore qualitatively. This research lies within the first situation because it is expected to calculate the degree of vulnerability, the scale of perception, and understand the context within which they are generated. Quantitative data are required to estimate the value for vulnerability and scale of perception while qualitative data are needed to study the context, social institutions, and political structures in which vulnerability exists, its consequences are exhibited, and adaptation measures influenced by perception are operative. However, there are a number of research designs available for mixed method research based mainly on how and when mixing occurs in the process to find better solutions to the inquiry under examination (Creswell & Plano Clark, 2007).

3.4 Research Design

Creswell and Plano Clark (2007) emphasize the importance of selecting a single specific design to examine a research question under a mixed method approach, mainly referring to its ability to guide the study through a proper framework and a logic and also to arrive at robust conclusions. Yin (1994) outlines research design in its most elementary sense as “the logical sequence that connects the empirical data to a study’s initial research

questions and, ultimately, to its conclusions” (p. 19). Creswell and Plano Clark (2007) succinctly define it as a procedure that is carried out to collect, analyse, interpret, and report data in research. Therefore, a design is a blueprint of the research that warrants the precise answer for the question under investigation (Yin, 1994). Likewise, the decision of a suitable design is predominantly guided by the research question (Morse, 2010; Yin, 1994) where the researcher's expertise, available resources (funding and time), and the audience also play a crucial role (Creswell & Plano Clark, 2007).

The evolution of the mixed method approach has produced approximately forty different design classifications (Tashakkori and Teddlie, as cited in Creswell & Plano Clark, 2007). These were summarized (Creswell et.al, as cited in Creswell & Plano Clark 2007) and then revised and organized into twelve main classifications (Creswell & Plano Clark, 2007). Though they appear to be very different from one another Creswell and Plano Clark (2007) argue that they share more similarities than there are differences between them. They identify four major functional mixed method design types: triangulation, embedded, explanatory, and exploratory. The design for this particular research best fits into one of the four classifications made by Creswell and Plano Clark (2007): triangulation.

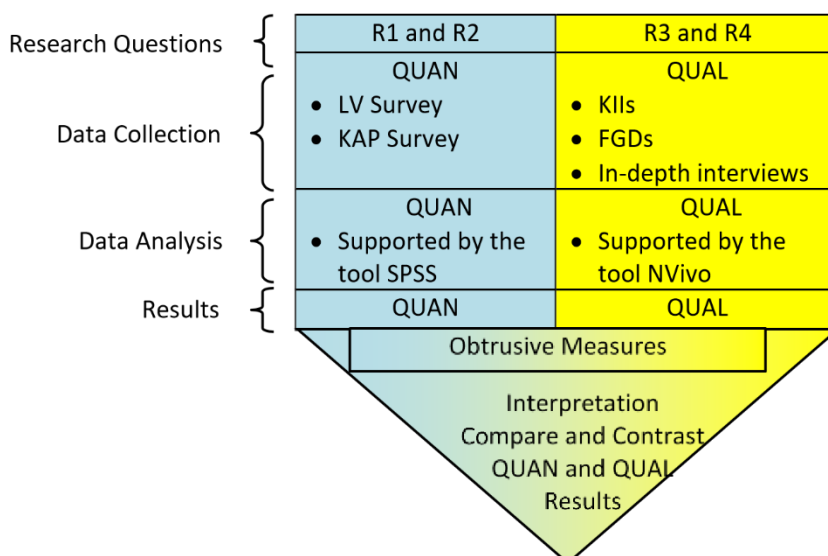
Creswell et al. (as cited in Creswell & Plano Clark, 2007) claim triangulation is the most commonly used design in a mixed methods approach. According to Morse (1991), this design gathers different yet complementary data sets on the same phenomenon. She further claims that these two data sets assist the thorough investigation of the research question (Morse, 1991). Patton (1990) asserts the design's capability of bringing both quantitative and qualitative strengths and weaknesses to a common platform in order to better understand the research question. For example, small sample sizes covered in the qualitative process can be complemented by the large sample sizes incorporated in quantitative studies (Patton, 1990). Similarly, Neuman (2006) claims that this application of triangulation in research methods fortifies the studies by providing a space for overlapping the strengths of both methods, however, recognizing the fact that some weaknesses of both styles remained untouched. He further asserts that observing things from different angles (the same principle surveyors and sailors apply to identifying the true location), is also applicable in social science to obtain better results. The importance of triangulation in social research is apparent (Neuman, 2006).

In this research, both qualitative and quantitative methods are given equal weight and deployed within a single timeframe as with the triangulation design (Figure 3.2). Data of two types

was merged during the analysis to better explain the answers for the research questions under investigation. Creswell and Plano Clark (2007) argue that the triangulation design assists researchers to draw a substantiated conclusion about their research question through valid comparison and contrasting of the different results. They further strengthen their argument with the example of Anderson et al., (1999) who converged their quantitative findings with qualitative results in drawing substantial conclusions (Creswell & Plano Clark, 2007).

Figure 3.2

The triangulation design



Note. Modified from Creswell & Plano Clark, 2007

R1=To what extent are coastal livelihoods vulnerable to weather-related stresses and climate change impacts?

R2= In what scale do coastal communities perceive weather-related stresses, climate change impacts, and associated livelihood vulnerabilities upon which their adaptation intentions and acts are constructed?

R3= What are the ways in which perceptions of communities are translated into behaviours in the event of weather-related stresses and climate change impacts?

R4= How the context specific economies, social institutions, and political milieu administer climate induced livelihood vulnerabilities, perceptions, adaptation intentions, and actions of these communities?

However, such a design has its weaknesses too. One is its requirement for expertise in both quantitative and qualitative methods. Another is the need for collecting additional data, in case quantitative and qualitative results are divergent and difficult to justify. Also,

converging two different data types generated from two different sample sizes is a challenging and difficult task (Creswell & Plano Clark, 2007). In this I was greatly assisted by my supervisors. Fortunately, both the quantitative and qualitative findings of this research were convergent, thus collection of additional data was not required.

In essence, the decision to employ the method of triangulation for this research is mainly based on the research question, as its purpose is to measure the existing vulnerability and the scale of perception of the coastal livelihoods while examining the reasons behind such measures and their relationships with adaptations in place. Similarly, it was influenced by several other factors, including available funding, timeframe, my own expertise, and expectations of the audience. Additionally, in an effort to develop the framework for the methodology, the dimensions of social research explained by Neuman (2006) were also considered.

3.5 Research Dimensions

Neuman (2006) describes four main dimensions of research: audience, purpose, time, and techniques, which support the development of rigorous research questions and suitable research designs. The first dimension, audience, distinguishes between basic and applied research, while the purpose explains the goal of the study. The third and fourth dimensions outline the timeframe within which the question is examined, and then the techniques used. These four dimensions are described in the following section with relevance to the research project and its theoretical perspectives as an overview of the overall process.

Briefly, a study that aims to advance existing knowledge or create new knowledge that underlies social reality is referred as basic research, whereas a study that addresses a specific social problem that in turn informs policies is designated as applied research (Neuman, 2006). Accordingly, the findings of these two types cater to two different audiences, the scientific community, and the practitioners. Yet both types cannot be separated by a clear-cut margin. In fact, they have a close relationship. As argued by Neuman (2006), an outcome of a basic research often provides the ground for applied research while an outcome of an applied research may assist existing knowledge. He further points out that policies will be misguided and ineffective in the absence of

knowledge of actual drivers of social behaviours (Neuman, 2006), thus highlighting the importance of basic research.

For example, it is crucial to understand why deviant behaviour occurs in a society in the first place, for practitioners who attempt to minimise violent behaviours through policy making. The deep-rooted causes that explain certain behaviours are revealed by basic research. Such findings are not always attractive to practitioners who seek for immediate remedies to solve pressing problems (Neuman, 2006). Creswell and Plano Clark (2007) claim that, despite the audience, all social research is based on a philosophical foundation upon which assumptions relevant to social realities are made. On this ground this research goes beyond the basic-applied dichotomy and attempts to address both audiences through the application of pragmatism. The objectives of this research are designed and implemented to add to existing knowledge of vulnerability, and perception of and adaptation to climate change impacts while identifying the pressing problems of such impacts upon which the community's adaptation mechanisms are built.

Babbie (1989) argues that, based on its purpose, social research can be framed into one of three main groups: exploratory; descriptive; and explanatory. Nonetheless, in Neuman's (2006) view, some social research can fit into more than one group simply because it has more than one purpose. This research which is supported by Neuman's view accommodates characteristics of both descriptive and explanatory research. Descriptive research depicts a picture of a social setting, situation, or a relationship, while explanatory research attempts to explain why the picture is portrayed in such a way. For example, descriptive research may disclose a percentage of children abused by their parents while explanatory research explains why that happens in the first place (Neuman, 2006). Likewise, this research aims to find out the degree of livelihood vulnerability which exists within five coastal GNDs of Chilaw DS and then to explain why they are faced with such a degree of vulnerability that eventually forces them to adopt certain perceptions and adaptation behaviours.

Time dimension in a study outlines the ways in which time is treated in the context of data collection and analysis. Accordingly, there are three main types of research: cross-sectional; longitudinal; and case study. Cross-sectional research examines information at one point in time whereas longitudinal research examines information over a period of time (Bryman, 2008; Neuman, 2006). To simplify, cross-sectional research is similar to a

story that a photograph tells, whereas longitudinal research is similar to a story that a movie explains. According to Neuman (2006), case study differs from the above two types owing to its depth of examination of a case or cases over a period of time. Following Neuman's (2006) argument, this research is a case study due to its interest in examination of livelihood vulnerability together with the associated concepts of perception and adaptation to climate change impacts in the case of the selected coastal community geographically located on narrow land between the sea and a lagoon.

The final dimension, data collection techniques, refers mainly to two types: quantitative and qualitative. The task is to select a technique that addresses the research question appropriately and that matches the researcher's expertise. This research was mainly guided by the mixed method approach. Thus, data collection techniques such as Key Informant Interviews (KIIs), Household survey, Knowledge, Attitude, and Practice (KAP) survey, FGDs, and in-depth interviews were adopted to gather both quantitative and qualitative data.

Overall, social research is guided by the dimensions of the audience, the purpose, the time, and the techniques (Neuman, 2006). That is the case for this research. The audience for this research is broader than adherents to basic versus applied paradigms, while it addresses both descriptive and explanatory purposes. In order to answer the research question, both quantitative and qualitative techniques are employed to collect data. From the perspective of the dimension of time, this study adopted a case study strategy.

3.6 Research Strategy

Case study strategy is the microscope in social science research because it has the capacity to uncover concealed realities through a rigorous focus (Hakim, 1987). Yin (2009) defines case study as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 18). In the same way, Green and Thorogood (2009) define it as "in-depth study undertaken of one particular 'case', which could be a site, individual or policy" (p. 284). Thomas (2011) also characterises case study as a type of research that focuses on a particular case in which the researcher attempts to dig deep in order to gain a thorough understanding and a holistic perspective. Similarly,

Bryman (2012) refers “the case” to a study that is conducted with specifics particular to a location. However, the case study is comprehensively defined by Stake (1995) as:

not a methodological choice but a choice of what is to be studied...By whatever methods we choose to study *the case*. We could study it analytically or holistically, entirely by repeated measures or hermeneutically, organically or culturally, and by mixed methods—but we concentrate, at least for the time being, on the case. (p. 443)

In summing up all those views, the case can either be a phenomenon under investigation, or a specific unit or setting such as a social group, a community, and an event existing within specific circumstances which are subjected to intense examination by a mixed method approach. As well, it can be both the phenomenon and the setting, subjected to similar type of investigation (Cronin, 2014). Thus, it is a useful strategy to gaining understanding of a context-specific contemporary phenomenon such as climate change and associated livelihood vulnerabilities, perceptions, and adaptation measures.

As a whole, a case study is a comprehensive research strategy (Yin, 1994, 2009). It is capable of generating deep and "multi-faceted understanding" (Crowe et al., 2011, p. 1) of an intricate issue in its natural setting. In its application as a strategy, it is most appropriate to answer “how” and “why” questions (Yin, 1994). Surveys have also been conducted within case studies to generate rigorous results with references to the phenomenon under investigation (Yin, 1994). Thus, case study is extensively used in social science research (Crowe et al., 2011) and utilized both to test and generate theories (Bryman, 2012). Eisenhardt (1989) further argues that the case study strategy supports creativity and also helps to unfreeze thinking. This can eventually lead to development of a novel theory. Case studies are useful strategies to understand context-specific climate change related phenomena such as vulnerabilities and adaptation (IPCC, 2001). However, it is vital to define what the case is and what the case is not at the beginning of the research process (Stake, 1995).

Accordingly, the case for this particular research was the coastal community of five adjacent coastal GNDs, predominantly their livelihoods upon which weather-related stresses and climate change have impacts. As such, the focus of this research is to examine and acquire a profound understanding of vulnerability of coastal livelihoods; the context

within which the contemporary phenomenon of climate change impacts is exhibited, and respective perceptions and adaptation measures are formed. Thus, given the nature of its focus and approach, I argue that the case study is the most suitable strategy for this research project in the context of the mixed method approach. Therefore, in this research the definition of the case was confined to a geographical location out of which samples were drawn, data were collected, the analysis was conducted, and findings were presented primarily according to the mixed methodological approach. A detailed and more specific geographic and demographic description of the case study area is presented in Chapter Four.

3.7 Population and Sampling Techniques

Neuman (2006) designates “a population” out of which samples are taken as an abstract concept, except for small, specialized populations, such as all students in a given classroom. Owing to this specific nature of “a population”, he emphasized the importance of having a good sampling frame in which approximately all elements of the target population are included (Neuman, 2006). In this research, the target population and/or sampling element were the coastal households, predominantly their livelihoods in the selected five villages of the Chilaw DS. The sampling frame was based on the list of households that is available with the *Grama Niladhari* (GN) of each GND. The GND is the lowest level of administrative unit of the central government of the country where GN (*Grama Niladhari*) acts as the most ground-level agent for this administrative body of the central government. The agent is responsible to the central government for the execution of the state rules and regulations at the ground level, collection of socio-economic information from the households, and also attending the conflicts among households as an intermediary to solve them at the basic level, among many other duties (MENR, 2011a).

The household lists which were utilized as sampling frames for each GND are updated by the GNs during the period of May to November every year based on the information given by households of each respective GND. Thus, their accuracy depends on what is given by the community whose information is not cross-referenced through a formal channel. For example, a person who moves permanently to an area outside the respective GND can still have his/her name on the list of the original GND which is generally filled by his/her family members. Nonetheless, as the GNs explained, there is little chance that the list ends up with faulty information because the households are well-known to them in

compact communities such as the ones investigated in this study. They further highlighted their close relationship with the communities. There are many informal communication channels that exist between GNs and communities, thus they are always in a position to acquire updated information about the households of their GNDs. In addition, there are many events and circumstances, such as applying for a school for a child, applying for a job, applying for subsidies, applying for loans from formal and informal banks, voting in elections, and even disputes with neighbours that are involved with GNs which provides the opportunity to cross-reference the information given by households.

The office of every GN, which is often a small room rented from a house or a small space occupied in a community building in the respective GND, further ensures accessibility to the community while supporting close relationships between the GN and the communities. I recognised that the GNs' list can still accommodate non-villagers, especially when the GN (which is a transferable position) is new to that area. Interestingly, two out of the five GNs of the selected GNDs were from the same community while the other three also live in close proximity to the selected villages, that is in Chilaw DS. Therefore, GN's list that was used as the sampling frame in this research can reasonably be considered as accurate, up-to-date, and complete, thus ensuring the good sampling frame and good sampling (Neuman, 2006).

The sampling techniques were determined by the type of research method (whether qualitative or quantitative) that was adopted to collect data. Following Flick (1998), "relevance" was prioritized over "representativeness" in selecting the samples for the qualitative study. Thus, a non-random purposive sampling technique was administered to select sampling elements for FGDs and in-depth interviews. The KIIs and household surveys which were conducted beforehand were useful in adopting purposive sampling to select participants for the in-depth interviews which were conducted in the final stage of the data collection process. Administering the purposive sampling was guided by the maximal variation sampling technique where the selected interviewees held different perspectives with regard to the central phenomenon which in turn yield a good qualitative study (Creswell & Plano Clark, 2007). These differences were mainly guided by different livelihoods, different age groups, different income groups, and difference in gender.

In all, 50 participants were purposively selected for the in-depth interviews. Three were later withdrawn from the process due to personal reasons. Five FGDs were conducted

with the available participants who were interested and also could commit their valuable time for the discussions. The number of participants for each focus group varied between five to ten. In-depth interviews and focus groups were conducted to identify the socioeconomic, political, and environmental factors that affect existing livelihoods and occupations in the communities. These modes of enquiry also elucidated attitudes and strategies towards adapting to or overcoming the factors that impact their livelihoods. Despite the need to organize focus groups according to livelihoods, four out of the five focus groups were represented solely by fishers. It was hard to organise them as groups because of their busy daily routines and lifestyle. Only one group was a mix of different livelihoods.

As argued by Neuman (2006), stratified random sampling can generate more representative samples than random sampling, provided that precise information about strata is available. Stratified random sampling was employed for the surveys conducted in this research where representativeness was crucial. This process was essentially assisted by the readily available well-maintained household lists in each GND, in other words by a good sampling frame (de Vaus, 1986). The stratification criterion was the main livelihood of each household, the sampling element of the sampling frame. The process of stratification allowed the inclusion of all types of livelihoods/occupations among the population in the sample, which in turn reduced the sampling error (Bryman, 2012). The six livelihood/occupation categories (six strata) common to all five GNDs were identified during KIIs and verified with the help of available literature in the field. They were: fishing and related trading; private sector employees; government sector employees; self-employed; and foreign employment.

The sample size of a survey is determined by several factors (de Vaus, 1986). According to Neuman (2006), the degree of precision, heterogeneity of the population, and the number of different variables under investigation are the main elements upon which sample size is based. However, in Bryman's (2012) point of view, in addition to those three, the sample size is subjected to several other considerations among which are absolute vs relative sample size, timeframe, cost, and non-response rate. Indeed, he believed time and cost played a prominent role in deciding a sample size in reality. This was one of the main deciding factors in this research. On the other hand, homogeneity exists within each GND/village and difficulty in arranging interviews led me to decide on a

small sample size (Neuman, 2006). Even though telephone and mail-out surveys were considered as alternatives for acquiring larger sample sizes for the study, given time and cost limitations (de Vaus, 1986), this was not a practical approach for this research, especially given the target population was not interested in such measures. Therefore, the sampling ratio³ for the surveys was maintained at 10% for each GND and consequently for the total of all GNDs.

Accordingly, in all, 206 households were selected out of total 2050 living in five GNDs for the surveys. Sampling started with the stratification. The percentage of each stratum or livelihood/occupation category for each GND was first calculated. Subsequently, the proportionate random sample of households was taken from six strata to account for 10% of the total households in each GND. I believe that the samples drawn from each GND allowed me to achieve the intended depth of the inquiries, regardless of difficulties in organising time with fishers for interviews, logistical requirements, and the time availability in the research.

Bryman (2012) advised focusing on three sources of sampling bias in order to obtain a representative sample with a small sampling error. They are: random sampling; adequate sampling frame; and less or zero percent of non-response. These three sources of bias were addressed to the largest extent possible in the surveys to minimize the sampling error. The first two sources were addressed through stratified random sampling which was based on the readily available and refined household lists available with each GN. The third, response rate⁴, was calculated as 100% based on the formula introduced by Bryman (2012). This response rate was a result of several techniques deployed during the process, in addition to generous support of the participants. They were: in-person interviews; pilot-tested questionnaires of optimal length (Fink & Kosecoff, 1998); carefully trained research assistants (Hoinville & Jowell, 1978) who were familiar with the field; the use of an interpreter during the interviews depending on the participant's requirement; and most importantly, the number of visits made to the field at several different times of the day and the week.

³ Sampling ratio: The number of cases in the sample/number of cases in the population (Neuman, 2006)

⁴ Response rate: Number of usable questionnaires/(total sample—unsuitable or uncontactable members of the sample) *100 (Bryman, 2012)

3.8 Data Collection Methods

The data collection methods were carefully selected to match the underlying assumptions of both the research philosophy and the tools of analysis, as well as for their capacity to answer the research question. Qualitative data collection was supported by participatory methods such as KIIs, FGDs, and in-depth interviews while household surveys were administered to collect quantitative data.

The participatory approach—one way to tap the immense knowledge possessed by poorer rural communities about the context within which they live and in which their livelihoods are originated (Foell et al., 2000)—has become an essential tool in livelihood development research (Reitbergen–McCracken & Narayan, 1998). According to Biggs (as cited in Merrill–Sands et al., 1991), the degree of community participation in research can be categorized into four main options. In order of their degree of involvement (from the lowest to the highest) they are: contract, consultative, collaborative, and collegial.

Contract and collegial are the two extremes of the participation spectrum. The former involves the lowest level of community participation while the latter indicates the highest level of participation in which the community take a leading, active role in the research process. In consultative research, the community's knowledge is used to a certain degree, and their participation is passive. In contrast, in collaborative research, the community plays an active role similar to that of the researcher (Merrill-Sands et al., 1991). The degree of participation, however, is decided by the aim and the type of the research. Accordingly, this research adopted a consultative approach, given its purpose was to understand the contemporary phenomenon of climate change and its impact on the livelihoods of coastal people in collaboration with the topics of perception, vulnerability, and adaptation. Consequently, KIIs, FGDs, and in-depth interviews were carried out to collect qualitative data.

Nonetheless, quantitative techniques such as surveys which are comprehensively supported by statistics cannot be replaced by participatory approaches (International Institute of Rural Reconstruction [IIRR], 1998). The surveys have the capacity to reveal the descriptive, behavioural, and attitudinal information of institutions and communities in an unbiased and scientifically rigorous manner (Rea & Parker, 2005). For the same purpose,

two surveys—a Livelihood Vulnerability survey and KAP survey—were carried out to generate quantitative data.

During the entire survey process, the majority (84%) of the interviews were conducted in Sinhalese, the national language of Sri Lanka, and 16% were conducted in Tamil. An interpreter, a member of the same community, was utilized in situations where the interviewee was more comfortable with Tamil than with Sinhalese. Research Assistants (RAs) identified those who needed an interpreter and those who did not, prior to the interviews, based on the list of randomly selected households which was given to them beforehand. However, the need for an interpreter was identified during the Key Informant Interviews (KIIs) and the effectiveness of using a member from the same community as an interpreter was measured during the pilot survey.

The measurement was done based on two elements: how accurate the translation was and how comfortable the interviewee was in the presence of a member of the same community. Testing of the first element was carried out through a friend of mine who was an outsider to the community and fluent in both Tamil and Sinhalese. She participated voluntarily in the pilot survey. During the pilot survey she carefully listened to both the interviewee and the interpreter and then gave me feedback afterwards as to how accurate the translation was. The second element, the appraisal of the interviewees' level of comfort, was based on observation. Depending on the feedback and observation together with the number of interviewees that required the help of an interpreter, I finally decided to obtain the assistance of community members as interpreters. Three female interpreters who were fluent in both languages of Sinhalese and Tamil and willing to provide their valuable service voluntarily were initially identified by RAs and utilized during the whole process.

However, the place of the interviews which is an important factor in certain research (Creswell & Plano Clark, 2007) was not carefully selected for this particular study as none of the research questions posed any threats to the participants. In administering the data collection, I and the team of research assistants made a concerted effort not to disrupt the flow of the households' usual activities while trying to maintain a standard protocol throughout the process, thus ensuring impartiality.

Permissions needed for the study were obtained prior to the research from all levels as stipulated by Creswell and Plano Clark (2007). The first approval was from the Curtin University Human Research Ethics Committee, and others followed from the Head of the Chilaw DS and the respective GNs who were the government officials in charge of the study area, and finally from the participants. Interviews were conducted at places which participants thought would be convenient for them. Accordingly, the survey interviews were conducted in each respective house of the household where either the head or/and spouse of the head of the household answered the questions. All five FGDs were also conducted at five houses of the five different participants. In contrast, in-depth interviews were conducted at different places such as: the beach; hut (*“waadiya”*); boats; harbour; GN’s office; on side of the small roads (where the fishers mend their nets); side of the lagoon; small retail shops; and in their own houses, at the convenience of the participants.

The field work was carried out over ten months from April 2015 to January 2016. During the first three months (April, May, and June), KIIs and FGDs were conducted, along with visits made to the selected field. Incorporation of the findings from KIIs and FGDs to the draft questionnaire, translation of the questionnaire from English to Sinhalese and recruitment of five Research Assistants (RAs) were also completed during those first three months. The next two months (July and August) were employed for training RAs, conducting the pilot survey, and further improving the questionnaires with findings of the pilot survey. Next, the household survey and KAP survey continued for three months (September to November). In-depth interviews were conducted during the final stage, taking two months (January and February) for completion.

3.8.1 Key Informant Interviews (KIIs)

This technique originated in cultural anthropology and was then extended to the fields of ethnographic and various other social science investigations (Marshall, 1996) because of its efficacy as a data collection method (Kumar, 1989). As described by Tremblay (2003), an ideal Key Informant (KI) should be in a position to acquire, understand, and properly communicate the information that a researcher seeks. In addition to these capabilities, a KI should be unbiased and have the willingness to share such information with the researcher (Tremblay, 2003). According to Burgess (2006) such a group of key informants with a broad range of views is unarguably, a rich source of information.

Marshall (1996) also notes that KIIs can successfully be adopted together with the methods of FGDs and in-depth interviews in qualitative inquiries that are complex in nature. Breaking down complexities into simple themes is a valuable ability of KIIs, at times providing basic guidelines for further inquiry (Kumar, 1989; Marshall, 1996). Thus, we decided to adapt KIIs in the initial stage of the process to understand the main complex and dynamic themes that lie beneath the coastal lives and livelihoods in the selected villages (Amoani et al., 2012).

In practice, as Jimenez (1985) states, KIs also act as facilitators and gatekeepers to a source of information related to people and events. Likewise, we utilized this technique also as a platform to inform all respective and respected authorities formally about the research and its aims as well as to inform people in close relationships with the field in order to have secure access to the community. By experience, I was aware of the disturbances that can emerge in the data collection process in the event that people are not informed beforehand. This was a lesson that I learned during a research process conducted to assess the impact of the 2004 tsunami in another coastal setting in the southern part of Sri Lanka. Lack of awareness about the program created unhealthy rumours among the community and even among the relevant authorities which eventually hindered the success of the program. Hence, the KI technique here was also useful both as a tool to penetrate the field and to gather knowledge about the field itself.

Another important aspect to consider in conducting KIIs is the validity of the findings. As argued by Kumar (1989), the validity of the findings is dubious if the number of KIs is below 15. Thus, 25 Key Informants (KIs) were selected initially on the basis of the attributes described by Tremblay (1989, pp. 151–163): role in community; knowledge; willingness to share the knowledge; communicability; impartiality; internal consistency; productivity; and reliability. Among them, 20 were in a position to allocate time for an interview while the rest could not fit into my timeframe though they were willing to participate (see Table 3.1). However, in selecting KIIs, the emphasis was on their ability to access the required information, because the primary aim was to set up the background for the data collection while reviewing the survey questionnaires for broader themes. I was well aware of the biases of this information, thus was planning to minimize this through other tools, such as a pilot survey, FGDs, and in-depth interviews.

Two executive-level personnel were selected from the office of Chilaw DS, the main government body responsible for all administrative and development activities carried out in the selected fields, in this case, the five selected GNDs. The Director of Fisheries of the provincial council represented the local council of the area. Five Economic Development Officers (EDOs), five *Grama Niladharis* (GNs) and five Parish Priests closely associated with the selected communities were also chosen. Interestingly, one EDO and two GNs were born and bred in three of the selected GNDs, thus three of them actually represented their communities rather than their respective offices. Therefore, only two community members were selected to cover the other two GNDs, namely *Kurusapaduwa* and *Weralabada*. The reason for selecting Parish Priests was the immense influence and the power the church has over these communities, sometimes more than that of the police. This relationship between fishers and the church is discussed in Chapter Six and Seven of the thesis.

The ways in which initial contact is made with KIs are crucial, especially in a setting within a developing country. One method is to utilize the links and recommendations of others to approach them (Kumar, 1989). I utilized this method of using links of others to approach the KIs initially unknown to me. Thereafter, contacts progressed smoothly with each introducing another. For example, the initial contacts were made with the Head of Divisional Secretariat of Chilaw DS and Director of Fisheries—Provincial Council through my husband and brother-in-law respectively, who used to work with them in the development activities conducted in these fields. Then they introduced me to other KIs listed in the table.

The time and venue for the interviews were decided by the KIs and each interview lasted between 40 minutes to 1 hour and 40 minutes. As suggested by McKillip (1987), the type of interview adopted was a personal face-to-face one, conducted with the help of a simple interview guide developed by following the guidelines of Kumar (1989). Accordingly, the guide consisted of a flexible checklist of areas intended to be addressed during the interviews. The areas included in the guide were primarily based on research objectives. However, during the interviews I was careful not to ask questions which could be answered with a simple “yes” or “no” option. Instead, many of the questions started with phrases, such as “please explain”, “please clarify”, “what were the main effects” and so forth.

The main findings of the KIIs were the need of hiring RAs to conduct the surveys; need of an interpreter for the Tamil speaking people; the difficulties that could be associated with interviews especially meeting times; type of livelihoods/occupations or strata to be used in the sampling process; and the need for adding a category of “shelter” to consider as part of the sensitivity discussion. Prevalent climate-related stresses and their impacts on livelihoods in the view of both authorities and the community were discussed. Also, the sampling techniques and the procedure were entirely based on the findings of KIIs and the existing records they shared with me during the interviews. During the KIIs, it was also revealed that it was difficult for an outsider to obtain the required information from the selected area, especially within a limited timeframe. Although I was born in a nearby village 12km away from the field and had a few connections with people living in the surrounding areas, that did not seem to be sufficient to conduct field research such as this. The initial connection needed to be built up through a channel familiar to the communities, in this case the GNs and Economic Development Officers (EDOs) of the area. Five EDOs were selected as RAs mainly to conduct the household survey for assessing the livelihood vulnerabilities of the selected five GNDs.

Prior to the interviews, the Key Informants (KIs) were provided with the printed consent letter and participant information sheet as required by the approved Human Research Ethics Protocol of Curtin University. I also explained the objectives beforehand in order to indicate the desired scope of the discussion. When interviewing GNs, EDOs, and community members who were not fluent in English, I explained what was on the printed papers in addition to stating the objectives of the research. This was managed in a manner that would not offend the KIs because their knowledge of English limited to some extent. None of the interviews were recorded but noted down on a notepad. I conducted all KI interviews and the medium used was Sinhalese, the national language of Sri Lanka. Table 3.1 presents the breakdown of the 20 KIIs conducted.

Table 3.1*Number and the type of Key Informants (KIIs)*

No	Description	No of participants
1	Administrative Head of Chilaw DS	1
2	Assistant Director of Planning (Development) of Chilaw DS	1
3	Economic Development Officers of Chilaw DS	5
4	Director of Fisheries—Provincial Council of Chilaw	1
5	Grama Niladhari	5
6	Parish Priests	5
7	Community Members	2
TOTAL		20

3.8.2 Research Assistants (RAs)

All five RAs were locals residing in Chilaw DS with one of them even being from one of the selected GNDs (*Weralabada*) although having worked as an EDO for another selected GND (*North Weralabada*). All of them were university graduates and each had nearly four years of work experience in the respective fields with which the survey was concerned. However, none of them had previously taken part in such a survey which was advantageous for me. Launiala (2009) highlights the difficulties of managing RAs who have had previous experience of conducting surveys guided by different objectives and methods. She believes it was difficult for them to unlearn things such as “probing techniques”, that they learned and used to collect data in previous surveys (Launiala, 2009). Fortunately, we did not face this kind of difficulty in this study as the RAs were fresh yet had the knowledge of surveys that they learned as a part of their basic degree.

The pilot survey was conducted by five RAs with assistance from me. My contribution to the pilot survey was major, but to the followings livelihood vulnerability survey (LV) it was minor. The main reason was that I simultaneously conducted the KAP survey in the field by myself. We adopted several techniques to avoid the biases that could result from the involvement of EDOs in the survey on livelihood vulnerabilities. First, the RAs were given six days of training to be familiar with and to understand what information each question in the questionnaire was expecting from the participant. Ethical conduct, and the

techniques of survey interviews together with the use of formal and informal language in interviews were also addressed.

On the first day, all five RAs were given clear guidelines as to what were the objectives of the research, ethical considerations, and the importance of avoiding a subjective approach in collecting data. The following day, the draft questionnaire was given to two RAs who were asked to explain what they understood from each question in the questionnaire. A similar session was conducted on the next day with the remaining three RAs and the way they interpreted each question was noted. On the fourth day, we all sat as one team and discussed the questions that any one of us interpreted differently. This session resulted in changes to the questionnaire, mainly in the wording of the questions. Such a procedure gave the RAs a sense of ownership, thus a sense of commitment. On the fifth day, the team went through the finalised version of the questionnaire and made sure all were on the same platform. On the final day, the RAs were trained in conducting interviews, including asking questions in different ways, verifying the answers with different members of the household, using informal language during the interviews, and avoiding probing or influencing the participants. That same day, a draft work plan was developed for the whole team. The session concluded with a few mock interviews. There was also further advice to the RAs to keep the questionnaires in a locked drawer to comply with the confidentiality statements and requirements of the ethics protocol. Further, the pilot survey, which was assisted by the RAs, acted as a trial session that improved their interviewing skills.

Secondly, the RAs were advised to avoid two main questions (discussed in sections 7.11 and 7.12) in the LV questionnaire (see Appendix B) which had the potential to create biased answers and consume much of their time. Those two questions were directly related to the conduct of the government during disasters which were sensitive for both the households and RAs. The questions were however asked and answered during the following KAP survey which I carried out with the same households.

Thirdly, my planned method of visiting households where the RAs had administered the LV survey beforehand functioned as a monitoring tool for assessing the accuracy of their work and the ethical integrity of the process. There were times that both a RA and I visited a household at the same time, and I took over from where the RA stopped, namely from the last two questions of the LV questionnaire. However, this was not always the case. As I

couldn't be physically present at five places at the same time where the five RAs conducted their surveys in the five GNDs, I moved between GNDs during the entire process. For example, one day I went to the field with the LV questionnaires filled by the RA in one GND, then the following day I visited another GND with the LV questionnaires filled by another RA. Usually, I collected all completed questionnaires from the RAs at the end of each working day and later examined them at home for any discrepancies. When I met the RAs the next time, the problems were either discussed and clarified or handed over to them for corrections. By the end of both the LV and KAP surveys, I was able to build up a good rapport with the community, thus was able to minimize any courtesy-biased answers during in depth interviews as they felt more comfortable to speak freely (Launiala, 2009).

Fourth, the LV questionnaire comprised multiple-choice questions except for three open-ended options, of which I asked two. The only open-ended question the RAs asked the participants was: "What helped your family to recover? What would have helped you recover better?" where both parties were comfortable in questioning and answering it during the pilot survey.

Finally, I was able to make the survey a collaborative effort by providing the RAs the space to discuss and criticize matters openly from the beginning of the process. We all assisted each other in difficult situations. For example, the RA of *Weralabada* asked me to accompany her for an exceptional interview which she was unable to complete during the first visit due to governance related questions raised by the head of the household. Apparently, he was having a problem with an officer in another department. The RA became the victim of this. However, the questionnaire was completed successfully without any further conflict with some additional knowledge on the processes and structures that exist within the respective community. Throughout the fieldwork, I adhered to the dress code recommended by the RAs. Though the RAs were remunerated for the questionnaires on LV survey, their sense of ownership and commitment was strongly evident in the quality of assistance given from KIIs to in-depth interviews.

3.8.3 Pilot Survey

Both the Livelihood Vulnerability (LV) and KAP survey questionnaires were piloted with 19 purposively selected community members who represented all five GNDs. This

selection involved all five RAs in the interviewing process, in which I also participated. Three interpreters were utilized in three interviews and the accuracy of their translation was assessed by an outsider who was fluent in both Sinhalese and Tamil. The behaviour of those three interviewees was also observed in order to understand the influence that the interpreters from the same community can have on participants' answers. The group represented four livelihoods: fishing; trading; foreign employment; and labour, whereas the majority, 68%, of households constitute only the fishing livelihood. The interviews were conducted at the houses of the respective households.

The pilot survey was conducted to review many aspects of the questionnaires: to check whether the multiple choices were mutually exclusive and provided all possible alternatives; to review whether the language or terms used in the questionnaire were clear and understandable; to review the order of the questions; to understand whether the questionnaires were too long or hard to read; to estimate the time each questionnaire would take; and to examine whether it addressed the phenomenon under investigation (Fink & Kosecoff, 1998; van Teijlingen et al., 2001).

As anticipated, the pilot survey suggested several important improvements to the LV questionnaire and its analysis. The first related to its length. Though we wanted to limit each interview to a maximum of one and a half hours, the pilot took nearly two hours or more. This required two alterations to the questionnaire. One was the decision to avoid two of the questions related to the main components of shelter. It was possible to understand these through participant observation, specifically data about availability of electricity and what the house is made of. In addition, during the KAP survey I was accompanied by my husband who made notes on the availability of electricity and telephone facilities, housing conditions, and other surroundings only by observing but not by asking the households. The other was the decision to avoid three of the four open ended questions. It was decided that these would be addressed during the KAP survey.

Secondly, there were changes made to the multiple choices included in the questionnaire. None required deletion, however a few multiple choices were extended for some questions. For example, the findings suggested the additional choice, "private water supplier" to the question, "6.1. Where do you collect your drinking water from?" The original options available in the questionnaire were: own well, own water line (government provided), neighbours/friends, common well/common water sources

including taps, water bowsers (government), supermarkets, and finally other. Approximately, 79% of the people wrote “private water supplier” under the option “other” during the pilot survey. Thus, it was added as a choice to the question 6.1.

Thirdly, changes were made to the questions and their wordings. Some additions and subtractions were made to the questions in order to avoid confusion and improve clarity. For instance, Question 1.10 was initially written as “Do you work in the same locality or in a different locality?” with the choices of “yes”, “no” and “both”. This created confusion whether to say yes to the people who work in the same locality or in a different locality. This question was later changed into “in which locality do you work?” and the participants were given three main choices: the same locality, different locality, and both. These statements associated with the questions were helpful to avoid any confusions that may have occurred during the main survey.

Finally, changes were made to the open-ended questions that were included in the draft questionnaire with the aim of gathering additional information. Initially, there were open-ended questions, such as “what are the reasons that your family member decided to go abroad?” and “why do you work in a different locality?”, which were left unanswered by two-thirds of the participants of the pilot survey. It seemed that the RAs did not put much emphasis on these qualitative questions in the procedure. When they were inquired for the reasons, many stated that those questions often changed the direction and flow of the questionnaire as the participants started talking about their difficulties. Thus, they were removed from the questionnaire. Later I acquired the relevant information during in-depth interviews.

The answers to the LV questionnaire in the pilot survey were then coded and tested with SPSS to check whether the findings support the development of the Livelihood Vulnerability Index (LVI). At this point we decided to add some additional indicators to the index which were supported by secondary data that measure climate variability.

Overall, the changes suggested by the pilot survey of the KAP questionnaire were fewer compared to the LV questionnaire except for a few context-specific multiple choices. For example, two additional choices namely “lightning” and “tornado” were added under “likely occurrence of events in the future”. Nevertheless, the pilot was useful in deciding on binary and ternary questions, particularly the legitimacy of using “I don’t know” as a

choice along with “yes” and “no” (Fink & Kosecoff, 1998). The findings from the pilot study suggested to retain “I don’t know” as one of the multiple choices in the KAP questionnaire for those who were genuinely unaware of climate change and its related issues. In addition, the decision to include questions relating to knowledge about greenhouse gasses was also tested during the pilot survey and proved to be worth retaining in the main survey.

The questionnaire for the KAP survey was not translated into local language for two reasons. Firstly, as I conducted it, I had the opportunity to explain the term *climate change* and its related scenarios to the participants from my knowledge of the subject and using the local dialect. After conducting KIIs, FGDs, and the pilot survey, we understood that the majority of community members were not familiar with the terminology of climate change though they experience it. In other words, the term proved too abstract for the majority, thus it had to be associated either with examples related to day-to-day life or what people had seen or heard from the TV and the radio which were the most familiar media to them.

Secondly, the questionnaire was built with the assistance of similar types of questionnaires available in the literature and consisted of generally agreed terms which were not understandable even when translated into Sinhalese. For example, the exact term for “climate change” in Sinhalese is “*Deshagunika Wiparyasha*”, generally used during formal forums and not understandable to many laypeople. The only way to communicate the idea to people in the community was to explain it through different examples and different words which were familiar to them.

However, in order to maintain standards and make sure each participant had access to similar information, some parts of the questionnaire comprised statements that described the scenario under which data was collected. For instance, in the KAP survey, climate change was described using the following statement: “Climate refers to the long-term pattern of weather in a particular region over a period of 30 years. When scientists talk about climate, they are looking at averages of precipitation, temperature, humidity, sunshine, wind velocity, tidal changes in the sea, and species reduction. Climate change refers to change in the long-term averages of daily weather. Next, I am going to ask you some questions about any changes you have observed in the climate here.”

3.8.4 Household Surveys

Both surveys, LV and KAP, primarily addressed the first and second objectives of the study while they also assisted the third and fourth objectives. Accordingly, the LV survey was mainly utilized to develop the Livelihood Vulnerability Index (LVI) whereas the KAP survey was employed to identify the scale of perception, knowledge, and attitude of the community regarding climate change and its associated vulnerabilities and adaptation measures. The dimensions and determinants of perception and their scales were the predominant focus of the KAP survey.

The LV survey was designed to capture data under main eight themes: socio-demographic profile; livelihood assets and practices; social and political networks; food; water; health; shelter and natural disasters; and warnings and impacts. Many of these were in line with Hahn et al. (2009). These themes addressed the contributory factors of vulnerability, namely exposure, sensitivity, and adaptive capacity (IPCC, 2001). The findings from the LV survey are presented in Chapter Five. The KAP survey primarily consisted of three sections: the knowledge of the community on climate change and its associated impacts and effects; the perception and attitude of the community in that regard; and the practices that are currently in place or potentially implementable in the future to offset the impacts of climate change. The KAP survey findings are discussed in Chapter Six.

Each survey comprised closed-ended questions except for three open-ended questions that were at the end of the LV questionnaire. In-person interviews administered in the surveys were helpful in verifying doubtful answers and discussing the complex subject of climate change (Rea & Parker, 2005). It took more than one hour to complete each questionnaire provided there was no disturbance to the interview. This was often not the case. There were times it exceeded more than two hours, particularly when the participant was engaging in some other activities, such as cooking, trading, sewing, drying fish, mending nets, collecting fish from their nets, etc. while answering the questionnaire. They were always encouraged to carry on what they had been doing while participating in the interview, which in turn contributed to the 100% response rate.

Relevant to the procedure adopted here was the one suggested by Rea and Parker (2005). They outlined eleven main steps to follow in surveys like this. They are:

- identifying the need for surveys to satisfy the objectives of the research
- preparing the work plan and the budget
- identifying an information base
- deciding on the sampling frame
- determining the size and the type of sampling
- designing the survey instrument
- conducting a pilot survey and selecting and training interviewers
- conducting the survey
- coding and computerising the collected data
- analysing and writing the final report (Rea & Parker, 2005).

However, in practice we made a modification to the process where the RAs were selected and trained prior to the pilot survey rather than before the household surveys. This modification proved successful in this specific context as we had the opportunity to improve the questionnaire with the inputs of the RAs who had been working with this community for four years. It also gave the RAs the opportunity to practise their interviewing skills during the pilot survey. In addition, the work plan and the budget which were developed during the second step were revised twice, first in the process of training interviewers (RAs) and then after the pilot survey.

3.8.5 Focus Group Discussions (FGDs)

In contrast to the surveys, qualitative methods like FGDs and in-depth interviews allow participants to elucidate their ideas (Ye et al., 2013). Focus groups in particular are helpful in eliciting a number of different views on a particular issue (Bryman, 2012). In addition, FGDs provide a space for participants to challenge each other's views and predispositions, thus they produce more realistic outcomes. The outcomes of FGDs can be considered as more naturalistic, due to the construction of meaning through discussion rather than in isolation (Bryman, 2012). Thus, the FGDs were administered in this research to examine and understand the socioeconomic and political factors which lie beneath the exhibited vulnerabilities, attitudes, and adaptation measures of these communities and their livelihoods in the event of climate change. FGDs mainly allowed deeper understanding of the context and improved the questionnaires of the household and KAP surveys.

Stirrat (1996) argues that the selection of groups for FGDs used in participatory research methods should be carefully carried out to avoid oversimplification of existing realities. Keeping that in mind, the focus groups in this research were chosen based on many criteria. First, several occupational groups were identified with reference to the updated records available with the Divisional Secretariat Office of the Chilaw DS. Secondly, the information gathered from the KIIs was carefully examined to see whether further divisions exist within the coastal livelihoods. Fishers for instance, can be divided into many groups based on several factors, such as techniques or fishing gears (active or passive), type of the boats (one day or multi day boats), the fishing location (lagoon, the sea, shallow sea, or deep sea), and usage of modern techniques (use of navigators or not).

After identifying the groups and subgroups, the composition of focus groups was decided, and I tried to proceed with the recruitment of participants. However, the recruitment proved difficult, and I had to rely on five poorly organized FGDs. The number of participants in these groups varied from 5 to 10, with the majority comprising five people. In addition, 97% of the focus group participants were represented only by fishers of all types, be it lagoon or sea fishery. This challenge was however, offset by a large number of in-depth interviews. This strategy is considered a reliable tool in social research (Bryman, 2012; Ye et al., 2013).

Accordingly, I adopted FGDs for this study to ensure content validity for many reasons:

- the outcome of FGDs can be considered as the sum of separate individual interviews as participants both query each other about the topic and explain themselves to each other (Morgan, 1997)
- the comfortable setting of experiences with similar others can provoke more open and honest discussion and obstruct misleading information due to peer pressure (Basch, 1987; Millward, 2000)
- FGDs allow multiple members to be consulted at one time, thus are cost and time effective (Basch, 1987)
- it informs item development in relation to content and phrasing (O'Brien, 1993)

3.8.6 In-depth Interviews

The in-depth interview is widely employed to collect qualitative data because of its flexibility, which is generally absent in techniques such as participant observation

(Bryman, 2012). Without asking questions of the people, it is difficult to understand how they organize their world and give meaning to it. Qualitative interviews open the path for the researcher to enter into the perspectives of other people (Patton, 2002). Accordingly, this study recognises that the perspectives of the target group are meaningful and applicable to understanding their context: specific climate change associated vulnerabilities; perceptions; and adaptation measures.

Interviewees were selected from the same group who took part in the household surveys. This made the comparison easier because the data were not compounded by different personal characteristics (Creswell & Plano Clark, 2007). Initially, 50 households were invited and willing to participate for the in-depth interviews, but three later withdrew at the last moment as the families left the village for two months over migrant fishing. This total number, approximately, is similar to 23% of the size of the quantitative sample, which is satisfactory in mixed method research, according to Creswell & Plano Clark (2007). They argue that in a triangulation mixed method research like this one, the findings can be better compared with larger qualitative sample sizes similar to quantitative, even at the expense of eliciting information from individuals (Creswell & Plano Clark, 2007).

All 47 interviews were audio recorded and later transcribed into English. The date, GND, type of livelihood, and the household number were recorded before each interview. This protocol was helpful in contextualizing the answers of the participants. All interviews were assisted by an interview guide and were semi-structured. The interview guide addressed three main objectives of the research, particularly the areas of climate change impacts as experienced in day-to-day life; associated socioeconomic and political factors of vulnerability; perception; and current and potential adaptation measures existing within the community. Semi-structured interviews are usually regarded highly as tools for investigating specific issues (Bryman, 2012). Most interviews, in particular interviews with fishers, were conducted in the field while they were mending their nets and preparing baits for the next day's fishing. During the interviews, I avoided any leading questions while trying to use comprehensible language appropriate for the participants. In addition to the recordings, notes were also taken during some interviews. These notes later assisted me in deciphering the recordings. Each interview took nearly one and half hours and sometimes more.

3.8.7 Unobtrusive Measures

Reactivity is a problem associated with obtrusive measures like interviews and FGDs (Kazdin, 1979; Webb et al., 1966). In other words, the presence of the interviewer in such assessments influences the performance of the subjects or participants (Kazdin, 1979). Unobtrusive measures which were defined by Denzin (as cited in Bryman, 2012) as “any method of observation that directly removes the observer from the set of interactions or events being studied” can be utilized to avoid the problem of reactivity (Kazdin, 1979). Webb et al. (1966) argue the importance of using unobtrusive measures in conjunction with obtrusive measures for a more effective triangulation. Neuman (2006) also asserts the usefulness of unobtrusive measures in cooperation with quantitative and qualitative methods to address a large number of questions. Based on both arguments, I decided that participant observation and archival records, two techniques often classified as unobtrusive measures, would be useful and could assist in generating valid and rigorous results, thus they were employed in the study.

The technique of participant observation is often used in conjunction with surveys and questionnaires to benefit from the process of triangulation (Abernethy et al., 2007). Similarly, participant observation was exercised at various times in this research throughout the process of the survey and qualitative interviews, especially to understand the daily routines and behaviours of coastal communities in their natural setting. Through observation of local culture, aspects of the economy, and political structures, I was able to see the linkages and networks existing within the community. I was accompanied by my husband during the two surveys and in-depth interviews. He took notes on what he saw and what he heard all through the process. This included: information about the condition and facilities of housing; the type of surrounding; the accompanying people in a discussion; the manner in which participants communicate with their household members and sometimes with neighbours; and even notes on local dialect specific to fishing and its related activities.

Archival records in this research mainly comprised reports from government offices located in Chilaw DS, except for one well-established NGO called Small Fisheries Federation in Sri Lanka which is largely involved in mangrove protection of the Chilaw lagoon. Records collected included census reports, project reports, progress reports, research reports on Chilaw lagoon, government plans, information booklets, documented

acts and policies, and photographs. Each field office that works mainly in the coastal community of Chilaw DS was visited during the research. They included the planning division of Chilaw DS, the provincial fisheries office of Chilaw, Fishery Inspector Office of Chilaw, Chilaw Harbour Cooperation, Marine Environment Protection Authority, and the Department of Coast Conservation and Coastal Resources Management. In addition to that, the head offices of the National Aquatic Resources Research and Development Agency (NARA) and National Aquaculture Development of Authority (NAQDA) which were located in Colombo were also visited. This information was useful in providing insights and validating responses from the discussions and interviews.

3.9 Limitations Encountered During the Data Collection

The major limitation during the fieldwork was finding a suitable time for the interviews. In regard to fishers, the majority were free of any work from 3 to 5 p.m. People who go fishing early in the morning (around 3 to 4 a.m.) usually come home around 11 a.m., then clean themselves and have lunch. After that they usually sleep for two hours. Then they start preparing nets and baits for the following day from 3–5 p.m. Some people even go fishing twice a day. These people go fishing again after 5 p.m. and come back around 9 p.m. It is also worth noting that this routine varies depending on their income levels and availability of fish stock. Some drive a taxi (a three-wheeler) after coming back from fishing to bring additional income to the family. Similarly, some respond to unexpectedly available fishing stocks by going to the sea at unusual times. These issues made it hard for me to arrange in-depth interviews and FGDs with fishers. However, frequent visits to the field inquiring about fishers' availability were sometimes successful in enabling completion of questionnaires. Many interviews were conducted when they were engaging in other activities, such as cleaning and mending nets. On Sundays, fishers do not go fishing and usually participate in church services. After that they enjoy the rest of the day either with their families or friends. I did not conduct any interviews on Sundays.

Better times for interviews with women were between 9–11 a.m. and 3–5 p.m. Women's routine includes preparing meals for the fishers, taking children to and from schools, feeding children, and sometimes going to the market to sell fish among many other chores. Buying for household needs is also usually done by women. However, they are usually available at home. As with the male fishers, some interviews were conducted while the women were involved in some other activities, such as cleaning, cooking,

feeding babies, drying fish and doing business like trading. There were also houses with extended families and parents living with the husband and wife. Interviews with those households did not involve many disturbances because other family members often helped the interviewee to focus on the interview by looking after the household. In order to make the interviews successful, the team and I always respected the routine of the participants. In all, interviewing the members of the community was not easy and was time-consuming, not because people were uncooperative but because they were occupied with many other activities to support their families throughout the day.

Translation of the LV questionnaire from English to Sinhalese was also difficult because some formal/written words in Sinhalese are rarely used in conversational language. For example, the Sinhala term for “livelihood” is “*jeewanopaya maargaya*” which is very rarely used in conversational language, particularly in these communities. If it is translated as “*rassawa*” which means “occupation” in English, people understand it. In fact, in colloquial language, the fishers often refer to their livelihood as “*dheewara rassawa*” which means “fishing” in English. Another example is the translation of the English verb “consume” to Sinhalese. The formal and appropriate translation of that word is “*paribhojanaya*”. Yet again it is very rarely used in spoken language. The everyday word for that is “*kaama*” which means “eat” in English. Because of the complexity existing in the formal and colloquial language of Sinhalese I decided to address this in two ways. One was to translate the questionnaire into Sinhalese with appropriate words which were often formal, mainly to protect its true meaning. The second was to use colloquial language during interviews. Thus, the communication between the interviewer and the interviewee would be efficient and would guarantee accurate and meaningful answers to the questions.

Another limitation I encountered during the KAP survey was investigating people’s knowledge on climate change-related subject matters, particularly their understanding of greenhouse gasses through questions like “what does greenhouse effect mean?” and “what are greenhouse gasses?”. These questions had been pilot tested to see how many people could answer them, and thus whether they could be used in the KAP questionnaire. Only one person answered those questions correctly in the pilot survey, reflecting their overall knowledge of the phenomenon. However, this encouraged me to leave those questions for the main survey to see the result for the overall community, as it

is vital for policy makers to recognize the level of knowledge about climate change in their target groups. During the main survey, these proved to be sensitive questions due to their association with knowledge, hence the dignity and pride of people. Many, particularly women, regretted that they were not fortunate enough to complete their school education. They perceive that as the reason why government officials did not respect their voices and concerns. Usually, the survey interviews of this nature lasted for nearly two hours.

Heavy rains experienced during the months of May, June, November, and January disturbed much of the fieldwork. Unplanned constructions and poorly maintained drainage systems resulted in flooded roads; thus, transportation was a problem during these times (Colombage, 2016; Priyankara et al., 2010). Though these conditions did not last for long during the period I was in Sri Lanka, it impacted heavily on the work plan and the number of interviews planned to be conducted during these times. For example, if the roads were flooded even for a few hours, planned activities had to be postponed, which eventually lengthened the process to ten months.

3.10 Data analysis and Synthesis

The forms of data available for the analysis encompassed survey questionnaires, interview transcriptions, field notes, and archival documents. In the early stage of the research, we were aware of the techniques that we were going to apply during the quantitative analysis. Indeed, as argued by Bryman (2012), that awareness had been important for me for designing the questionnaires, deciding on the type of data and the nature and the size of the samples. Likewise, survey questionnaires of this research comprised all variable types; dichotomous (e.g. gender), nominal (e.g. the mode of transport), ordinal (e.g. time taken to the hospital) and interval/ratio (e.g. age). Of the majority of the KAP survey questions used, ordinal measures illustrate an order, but not the degree of difference between the measured items. The nominal measures were prominent in the LV questionnaire. Randomly selected households from each GND constitute the sample which was subjected to statistical inferences. The unit of analysis was the household.

Any statistical procedures for the surveys were fundamentally guided by literature on surveys. Accordingly, the responses to the two surveys were analysed using quantitative

coding and frequencies. The Livelihood Vulnerability Index was derived from the descriptive statistics that was supported by the tools of SPSS 22 and MS Excel. A similar procedure was followed to analyse the KAP survey questionnaires. The findings of the LVI are detailed in Chapter Five and the KAP survey findings are discussed in Chapter Six.

Compared to quantitative analysis, the codification of analytic procedures is not available in qualitative analysis. This is preferred by many social science researchers because of the nature of qualitative analysis which often evolves during the process. Nonetheless, broad guidelines on qualitative analysis are available to understand the rich yet cumbersome databases that rely upon prose (Bryman, 2012). Guidelines given by Bryman (2012) on general strategies of qualitative data analysis and basic operations in qualitative data analysis were followed during this research.

The qualitative coding was decided based on my experience and upon concepts, and theories stated in the literature. The process of coding was helpful for defining the categories during the classification of data (Frankfort–Nachmias & Nachmias, 2007) which in turn helped me to organise and understand the data. However, I started coding during the process of translating and transcribing interviews from audio tapes in Sinhalese to English. In a way, this process helped me to familiarise myself with the data. Some codes however overlapped among themes but were easily identifiable with the support of NVivo. We employed Computer Assisted Qualitative Data Analysis Software (CAQDAS) like NVivo during the analysis mainly because it was fast and efficient, transparent, and allowed many explanations (Bryman, 2012).

3.11 Validity and Reliability

Validity refers to the accuracy of the inferences (either deductive or inductive) made by the study whereas reliability denotes consistency of such findings under the same conditions (Creswell & Plano Clark, 2007; Tashakkori & Teddlie, 2003). In other words, these issues speak of the truthfulness of the research, thus its importance to knowledge development. A mixed method study like this one must comply with both the validity and reliability measures that are associated with quantitative and qualitative methods to the utmost extent possible (Creswell & Plano Clark, 2007), keeping in mind that perfect validity and reliability are impossible to achieve (Neuman, 2006).

In assuring quality, this research focussed on three main tests proposed by Yin (1994). They are: internal validity, which refers to the precision of the inferences made during the research; external validity, that explains the extent to which the research is generalizable; and reliability, which suggests the consistency or generation of similar results if the same procedures are repeated under similar conditions (Neuman, 2006; Yin, 1994). Several techniques were applied during the study in order to adhere to these aspects of the quality of the research.

Internal validity of the survey instruments was assured and improved through the pilot surveys of the research (van Teijlingen et al., 2001). Also, this study was facilitated by a diverse range of techniques that gather both quantitative and qualitative data which in turn supported the internal validity of the research (Ritchie et al., 2003; Stake, 1995). It granted me the opportunity to generate a holistic view of the phenomena under investigation (Crowe et al., 2011). Replicability, which is very close to the idea of reliability or precision, is only possible with the availability of clear and detailed procedures for the research (Bryman, 2012). Therefore, the methodologies are extensively detailed in the thesis. Limited time and prohibitive cost did not allow me to apply the test–retest method that ensures reliability through stability. Finally, the random sampling procedures administered during the surveys assisted the external validity yet are generalizable only to the selected population of Chilaw DS and communities elsewhere with similar attributes (Bryman, 2012).

3.12 Ethical Considerations

The research was at all times guided by the Australian Association for Research in Education's Code of Ethics and Guiding Ethical Principles of Curtin University. All participants were adults who were above 18 years old, and their identity and all other particulars were kept confidential. Also, all participants were fully informed about the research and its details, including confidentiality and data storage. The research team was particularly careful not to raise false expectations among the community about the short-term and long-term benefits of the study by clearly stating the objectives of the research prior to each interview. The team was always respectful of the knowledge, traditions, and religious observances of the community while making an effort to put people at ease during the process. Interviewers also strove to make the data collection procedures minimally disruptive of the daily routines and livelihood activities of the participants.

At all times, the interviews were arranged and conducted with verbal consent and according to the participants' preferences. If there was ever planning to take photographs or record interviews, the participants were clearly informed about this. Such plans proceeded only if permission was granted. It was ascertained that all participants were mentally and physically well and sound, so that neither the study nor their lives would be negatively impacted. All the data collected were on the participants' perceptions, ideas, and suggestions. My team and I did not enforce or encourage participants to adhere to any particular views. No interview schedules or FGDs exposed anybody to a risk greater than they faced in their normal daily life routines. From the beginning to the end, we acknowledged all people and resources that contributed to the thesis.

Chapter 4. Results: Participant Demography and Livelihood Prospects

4.1 Introduction

This chapter provides an overview of the parameters and the context of the case study, giving priority to the socio-demographic profile of the participants (Section 4.5) and identifying perspectives for both fishery (section 4.6) and non-fishery (section 4.7) groups in the area in relation to climate change. The geographical, economic, psychological, and political positioning of the study is presented using both primary and secondary data collected through the literature review, surveys, interviews, and unobtrusive measures.

In the study I adopted an approach of “no regret measures”: the “Precautionary Approach” (PA), rather than a similarly named “Precautionary Principle” (PP) approach. These terms are often used interchangeably in the literature, although their literal meanings are different (Wang, 2011). In this study I have chosen to use PA rather than PP as it is the concept used in the Rio Declaration on Environment and Development (1992). This cornerstone of the definition of sustainable development has been adopted by many national legislations and international treaties, including international laws pertaining to the sea, such as the Fishery Law (Wang, 2011).

The PA scenario for this study was adopted for three main reasons. The first is the scarcity of relevant literature on the topic of climate change impacts on the Sri Lankan Coast encompassing the projected models. A few vulnerability studies have been conducted by the Ministry of Environment and Natural Resources and the Disaster Management Centre (DMC) but many of these were still limited to provincial and district levels (DMC, 2012; MENR, 2010; MENR, 2011a). The second is that high uncertainty and greater complexity prevail in the phenomenon itself where the impacts grow faster than the ability of societies to recognize and respond to them (Kriebel et al., 2001). Third is the political demagoguery that climate change could bring into force (Gollier & Treich, 2003).

As Gollier and Treich (2003) argue, scientific uncertainty together with the complexity of the phenomena of climate change can generate political demagoguery, where the situation can be used by politicians for their own advantage. In their own words: “Indeed, given the complexity of the underlying scientific problems, the public is, in general, less informed than politicians about some particular danger. Then, politicians with strong career concerns may prefer to select the risk policy that the public believes is good rather than

the one which is actually good for the public” (Gollier & Treich, 2003, p. 121). Despite these arguments, every nation determines its level of protection based on the economic and socio-political priorities they have in place even in the absence of PA. Yet, as argued by von Schomberg (2012), the PA has the ability to influence such normative political decisions by giving a procedure or a rationale for action in the event of scientific uncertainty. In other words, the invocation of PA in the initial stage is purely political, based on “perceived risk”, yet one that comes with a rationale (von Schomberg, 2012). Thus, PA provides the ground for all stakeholders to account for the actions they take (Gollier & Treich, 2003). It is also important to note that the measures adapted on the ground of PA have to be regularly reviewed and altered depending on what science calls for, to either relax or strengthen the precautionary measures in place (von Schomberg, 2012). Significantly, the history of Sri Lankan politics reveals several examples of political opportunism and authoritarian politics (Gunasekara, 2020; Jayasuriya, 2019; Miap, 2018; NAFSO, 2012). Thus, the importance of adoption of PA for the betterment of the country’s vulnerable coastal communities in the event of climate change is clear.

4.2 Participant Demography

This section analyses the sample’s demographic characteristics based on the data collected during the two main surveys—Livelihood Vulnerability (LV) and Knowledge, Attitude, and Practice (KAP), with the same 206 residents in the five coastal villages of Chilaw DS. Stratified sampling was employed in the surveys for the fair representation of different livelihoods existing on the coast with an expectation of gathering varied perspectives on climate change. For the same reason, purposive sampling technique was adopted to collect qualitative data (Creswell, 2012). Collectively, 23% of the surveyed respondents (47 members) participated in qualitative interviews.

Two questionnaires—the LV survey and KAP survey—collected socio-demographic data including age, gender, marital status, the level of education acquired, occupation, the length of experience in the occupation, and size and composition of the household in addition to the livelihood vulnerability and perception related data that are discussed in Chapters Five and Six of the thesis. The sample selection is detailed in Chapter Two under methodology.

The respondents who expressed their major concerns during the surveys were divided into two main categories based on their livelihood or source of main income in order to understand how people in these two categories perceive climate change in their coastal environment. This was in response to one of the aims of the study, namely, to understand any existing differences within the varied types of coastal livelihoods which may have an association with different types of practices they exercise in defending themselves against the impacts of climate changes and variabilities. The categories were fishery (and related), and non-fishery. Fishery represented both boat owners and day labourers who work in the boats. The fishery-related group was mainly comprised of dried fish entrepreneurs, retail fish sellers, and net menders. The non-fishery group constituted primarily government employees, private sector employees, self-employed individuals, owners of grocery stores, and remittance earners. As with the overall population profile, in the sample, the majority of the livelihoods are in the fishery and fishery-related categories.

Table 4.1 presents a summary of the socio-demographic status of the respondents. It shows that the highest female representation of the study was recorded by *Weralabada* (14.1%) and *Kurusapaduwa* (12%) whereas the male participation in the other GNDs exceeded 90%. These GNDs also had the highest number of widows, 8% and 10.3% respectively. In addition, the GND with the highest percentage of participants in the “above 60 years old” category was also recorded in *Kurusapaduwa* as 12%, while the lowest for the same age category was recorded in *South Weralabada* with 5.8%. The maximum percentages of 60% and 56% for the age category of “20–40 years old” were recorded in *Kurusapaduwa* and *Egodawataa*. The remaining (*North Weralabada*, *South Weralabada*, and *Weralabada*) were estimated to have the highest percentage of participants from the age category of 41–60. Overall, the mean value of the age of all research participants was calculated as 43 years.

As part of the socio-demographic profile of the participants, their marital status was included, which in a way defines their gender roles. This was of particular interest owing to the different traditions related to marriage in the areas of the study. All respondents from *Kurusapaduwa*, *North Weralabada*, and *Weralabada* were married while only *South Weralabada* (1.9%) and *Egodawatta* (4%) had unmarried or single participants. This reconfirms the findings of Lawson (2014) who claims that marriage is an inherited phenomenon in coastal communities which defines the division of labour—men fish and

women trade. In accordance with this, all the fishers of the study were male. The marriage tradition in Sri Lankan coastal zones is usually different from that in other parts of the country. One of the main differences is that the eldest daughter inherits the property owned by the parents, thus it is customary for the partner who marries her to come and live with the parents. This is opposite to practices in other parts of the country, where the youngest son is entitled to the main house of the family while the male partner of a daughter takes the bride to his home after the marriage. This preserves the pride of the male, whose dignity and ability to build his own place and bring a wife to look after it is upheld.

The coastal communities seem to have a different viewpoint, thus they have a different practice. As a household from *Kurusapaduwa* explained, the tradition they follow is:

Usually here it is the elder daughter's responsibility to look after the parents when they are in time of need. Because by the time parents are old and weak, there is a high chance that the eldest is in a position to take care of them, but not the youngest. So, the man who marries the eldest daughter in the family comes and lives in the bride's home. But there are many families you can find here in this area where more than one family live in one house, because all can't afford to buy a land and build a house. (Household No 108 of *Kurusapaduwa*)

Another socio-demographic aspect investigated in the surveys was the size of the household, owing to its direct relationship with the dependency ratio. Accordingly, overall, the household size of each GND is not large, even though 20% was recorded by *Egodawatta* for "household size above 10". The majority of the participants belonged to household categories of "1–4 members" and "5–6" members in the other four villages except for *Egodawatta* where the highest proportion, 36%, belonged to the category of "7–8 members". *Egodawatta* had the highest representation of "fishery and related" livelihoods of 84% whereas the rest of the GNDs' representation of the same category was: 68% (*Kurusapaduwa*), 73.1% (*North Weralabada*), 78.8% (*South Weralabada*), and 61.5% (*Weralabada*).

Education level was also recorded during the surveys, premised on two main arguments. One is that education creates more opportunities, thus assures security of consistent income. Secondly, higher education levels assist the decision-making processes

of the households where people presumably have more analytical skill than uneducated or less educated people can apply. The majority of the participants either achieved primary level education (Grade 1–5) or junior secondary education (Grade 6–9). Each GND maintained a value below 10% for the category of people with no formal education. The recorded value of 20% and 21.8% participants in *Egodawatta* and *Weralabada* respectively is for people who were able to continue their education until collegiate level. Two participants (3.8%) from *North Weralabada* earned degrees from government universities, which are believed to offer a higher standard of education than the private universities in Sri Lanka. This satisfactory level of education can be attributed to the education law of Sri Lanka which made schooling mandatory for children up to the age of 14 (until grade 9). However, as household No 77 stated, fishers used to go fishing with elders while they were schooling:

Ohh a long time ago we started fishing. We were small kids at that time, and we thought it was fun. So, we never had a chance to be good students at school because we did not attend school continuously. When our parents went outside from this area for fishing, we all went with them. So sometimes even for 3–4 continuous months we missed school. How can they leave us behind? So, we went with them. (Household No 77 of *Weralabada*)

Table 4.1

Socio-demographic profile of the participants (%)

Category	Items	GNDs				
		Kuru	NW	SW	Ego.	Wera
Gender	Male	88	96.2	96.2	92	85.9
	Female	12	3.8	3.8	8	14.1
Age	Below 20 years old	0	0	1.9	0	0
	20–40 years old	60	42.3	32.7	56	42.3
	41–60 years old	28	57.7	59.6	36	51.3
	Above 60 years old	12	0	5.8	8	6.4
Marital status	Single	0	0	1.9	4	0
	Married	92	96.2	90.4	96	89.7
	Widow	8	3.8	5.8		10.3
	Divorcee	0	0	0	0	0
	Abandoned	0	0	1.9	0	0
Education	None	8	7.7	9.6	0	1.3

Category	Items	GNDs				
		Kuru	NW	SW	Ego.	Wera
	Primary (Grade1–5)	44	50	40.4	24	42.3
	Junior Secondary (Grade 6–9)	40	30.8	44.2	52	24.4
	Senior Secondary (Grade 10–11)	8	7.7	3.8	20	21.8
	Collegiate (Grade 12–13)	0	0	1.9	4	10.3
	Diploma or equivalent	0	0	0	0	0
	Degree or equivalent	0	3.8	0	0	0
	Other trainings	0	0	0	0	0
Main source of income	Fishery	68	73.1	78.8	84	61.5
	Government employment	0	3.8	3.8	0	1.3
	Private employment	0	3.8	3.8	4	9
	Self–employment	12	3.8	1.9	8	2.6
	Foreign employment	12	11.5	9.6	4	19.2
	Trading	8	3.8	1.9	0	6.4
Length of experience (Only for Fishery)	Below 4 years	0	0	0	0	0
	5 to 10 years	4	0	1.9	0	0
	11 to 16 years	8	3.8	7.7	0	5.1
	17 to 22 years	4	7.7	3.8	24	3.8
	23 years & above	84	88.5	86.5	76	91
Size of the household	1 to 4	36	42.3	44.2	16	43.6
	5 to 6	52	53.8	40.4	28	38.5
	7 to 8	12	3.8	7.7	36	12.8
	9 to 10	0	0	5.8	0	3.8
	Above 10	0	0	1.9	20	1.3
Sample size (n)		25	26	52	25	78

Note. Kuru = Kurusapaduwa; NW = North Weralabada; SW = South Weralabada; Ego = Egodawatta; Wera = Weralabada

For that reason, it is difficult to make a fair judgement of the respondents' education level based solely on the grades that they have passed, even though that approach provides an idea of the length of time they attended school, whether continuously or intermittently. On the other hand, some left school for fishing not because it was exciting, but because it was necessary due to financial and other hardships. According to household No 99:

From the day we were born to today we have been suffering in life. Our parents were very poor, so I never got a chance to enjoy school even though I wanted to. We had to neglect schooling. We only went there to be marked as “present”... I did not blame my parents. But now as a young man I have to do something about it. I am exhausted of being poor. We hate the days that we all had nothing to eat. The Government does not look after us. In fact, they bother us giving a list of “not to do” things. And we don’t have anyone in abroad to take us there. And we don’t have money to pay for boats that go to good countries. (Household No 99 of *Egodawatta*)

The other distinct element noted in the sample was the number of people abroad. The highest figure of 19.2% for foreign employment was evident in *Weralabada* whereas *Kurusapaduwa* and *North Weralabada* respectively recorded 12% and 11.5% respectively for the same category. Foreign employment, however, is of two types, legal and illegal. Many of the women who work in countries like the United Arab Emirates (UAE), Cyprus, and Lebanon as housemaids and men in UAE as fishers have legal employment. However, a number of males migrated illegally to the UK, Australia, and Italy in the early days from the 1990s to 2010. Still, young people in particular dream of going to those developed countries by any means. They believe that their familiarity with the sea makes them invincible so that they could take such a journey no matter how dangerous it is. This intention of migrating to countries illegally is further strengthened by the example of successful endeavours made by some former residents in the village. The president of the Fisheries Society of *Kurusapaduwa* opined that:

You know our lads are clever. They can fix any boat and they can take any journey. We are good fishers that have been fishing for so long. We know the sea well. We are capable of fixing any problems in the boat. So, going there is not that difficult for us. The only thing is how to escape to their land. We know there were many who were caught after reaching there. (Household No 104 of *Kurusapaduwa*)

The majority of the fishers who took part in the survey had more than 22 years of experience and boasted about their skill at, and knowledge of fishing. The interviewed authorities—in particular the Director of Fisheries of the provincial council and GNs of all GNDs—affirmed the same and further mentioned the demand these fishers have from

outside traders⁵ due to their skills and knowledge in fishing. This is also the reason for conflict between these fishers and the fishers in the areas to which they usually migrate as sometimes those fishers are not as skilled as the fishers of Chilaw. The estimated percentages for the category of “more than 22 years of experience in fishing” in each GNDs was; 84% (*Kurusapaduwa*), 88.5% (*North Weralabada*), 86.5% (*South Weralabada*), 76% (*Egodawatta*) and 91% (*Weralabada*). Only two GNDs noted very low percentages of 4% (*Kurusapaduwa*) and 1.9% (*South Weralabada*) for fishers with 5–10 years’ experience of fishing while the rest claimed more than 10 years of experience as a minimum.

To summarise, the male representation of the study was above 85% for all GNDs. All of them are married, and for more than 61.5% of them, fishing is their livelihood. Only men are involved in fishing whereas the rest of the household duties are generally carried out by women, in addition to the livelihood activities they conduct such as trading fish and making and packing food parcels to share the financial burden of households. Some of the women work as housemaids abroad. The majority of the participants belonged to two age categories of “20–40 years old” and “41–60 years old”. The highest number (12%) for the “over 60 years old” category was recorded in *Kurusapaduwa*. Over 90% of the participants in each GND had passed “grade 5” while the 10.3% of residents of *Egodawatta* had achieved collegiate level (grade 12–13) education, the highest of the five GNDs. Despite their considerable achievement in education, the majority of the respondents from each GND claimed “over 22 years” of experience in fishing, which, given their age statistics, implies they were involved in fishing while at school. The majority of the households constituted either “1–4 members” or “5–6 members”. In contrast, *Egodawatta* recorded a substantial percentage of 20% for the household size category of “over 10 members”. Other than fishing, coastal livelihoods in the study area comprised a few other types, including government sector employment, private sector employment, self-employment, remittance earners, and trading. A remarkable 19.2% of remittance earners were recorded in *Weralabada*, while *Kurusapaduwa* and *North Weralabada* recorded 12% and 11.5%, respectively. The estimated value for the other two GNDs for the same category was 9.6% (*South Weralabada*) and 4% (*Egodawatta*). However, remittance earners mainly comprised of three tiers: men who work as fishers in UAE,

⁵ They are the traders (“*Mudalali*”) who help these fishers to out-migrate to their areas for fishing. They bear the expenses of necessities of fishers during that time and take the responsibility of trading the fish. The profit is shared among these two parties, where the majority (75%) goes to the *Mudalali*.

women who work as housemaids in UAE, Cyprus, and Lebanon, and men who illegally migrated to Italy, the UK, and Australia. Illegal migration to countries like the UK, Australia, and Italy, seems to attract the attention of some people in the area as they have heard and witnessed stories of success. However, recent failed attempts by five residents have prompted them to at least weigh the positives and negatives before engaging in that costly process. None of the fishers who spoke about it seemed to evaluate the danger associated with such a process, but rather, considered the associated cost and probability of escaping to the lands without getting caught.

Understanding the socio-demographic profile of the respondents is an integral step of many climate-related studies. There are many scholarly works which attempt to establish a relationship between socio-demographic profiles and respective vulnerabilities and adaptation mechanisms (e.g., Abid et al., 2015; Amos et al., 2015; Ayanlade et al., 2017; Hasan & Nursey–Bray, 2018; Le et al., 2016; Leiserowitz, 2007; Opiyo et al., 2016; Shi-yan et al., 2018). However, premised on the findings of an empirical study on perception and climate change, Grothmann and Patt (2005) argue that psychological variables are more capable of predicting self–protective behaviour than are socioeconomic variables in climate-related studies. Despite the arguments as to which aspect is most important and influential in climate change related decisions of an individual, overall, these arguments suggest the potential for both psychological and socioeconomic factors to influence decision making.

Therefore, the perceived concerns related to both fishery and non-fishery groups in each GND were also closely examined in order to understand the diverse psychological perspectives existing within the study group. The fishery group mainly constitutes boat owners, day labourers who assist them, dried fish entrepreneurs, retail fish sellers, and net menders while the non-fishery group is comprised of government employees, private sector employees, self–employed households, owners of grocery shops or petty shops, and remittance earners.

4.3 Prospects of Fishery and Related Livelihoods

People have different priorities in their lives with which they may have to deal with regularly or intermittently. Even issues which are not high priorities for people can have enormous impacts. Obviously, climate change is one of these, thus, the importance of acknowledgement of its

existence and inclusion of it in the list of major concerns in order to act upon its impacts. Hasan and Nursey-Bray (2018) argue that it is crucial to understand the priority people place on climate change impacts among other socioeconomic and political encounters in which they are involved for their survival and wellbeing. The responses they practised as a solution to one concern can assist with the solution to another, thus it is important to consider them all. For those reasons, the first question asked during the KAP survey was “what issues in relation to your livelihoods and wellbeing trouble you the most?”, be it climate related or not.

Tabulated results (see Table 4.2) illustrate the perceived major concerns of fishery and fishery related respondents of each sector together with their frequency percentages. The length of the data bar in each cell compares the value of each perceived concern across the five GNDs. For instance, the highest percentage for alcoholism (65.9%) was recorded by *South Weralabada*, while the lowest (57.1%) was recorded by *Egodawatta*, thus *South Weralabada* has the longest bar covering the whole cell while *Egodawatta* has the smallest bar. The data bars featured for alcoholism along the row also demonstrate that approximately similar percentage of respondents in each GND perceived it as a major problem.

The overall analysis of the data bars shows that there is little variation in the major concerns of respondents from each GND, except for some specific stressors such as encroachment of the lagoon and the beach, ownership of the land and government restrictions on building permanent protective structures. However, the data bar in each cell does not compare data across the column, or how the percentages vary between different perceived concerns.

Table 4.2

Percentages of perceived major concerns of the fishery and fishery related households

Perceived as major concerns	Kuru	NW	SW	Ego	Wera
1. Social	43.7	33.1	36.2	29.2	31.0
1 Alcoholism	64.7	63.2	65.9	57.1	64.6
2 Drugs	17.6	26.3	19.5	33.3	29.2
3 Competition (over wellbeing)	35.3	15.8	31.7	23.8	31.3
4 Ownership of land	64.7	42.1	29.3	19.0	25.0
5 Objections from authorities to building permanent protective structures	47.1	10.5	17.1	0.0	0.0
6 Encroachment of the beach and the lagoon	41.2	0.0	14.6	4.8	4.2
7 Lack of mobility during a disaster	35.3	73.7	75.6	66.7	62.5

Perceived as major concerns		Kuru	NW	SW	Ego	Wera
2. Economic		77.5	75.4	78.1	67.5	74.7
1	Variable income from fishing	94.1	100.0	95.1	90.5	100.0
2	Cost of food	88.2	94.7	92.7	85.7	89.6
3	Cost of children's education	94.1	73.7	68.3	85.7	91.7
4	Cost of fishing gear	47.1	57.9	73.2	28.6	60.4
5	Maintenance cost of boats	58.8	57.9	63.4	61.9	35.4
6	Cost of fuel for boats	82.4	68.4	75.6	52.4	70.8
3. Political		72.6	69.3	71.5	75.4	77.1
1	Bribery and corruption	88.2	84.2	82.9	95.2	85.4
2	Negligence (misplacing of documents by government officials)	70.6	52.6	58.5	61.9	87.5
3	Abandoned as a community where farmers are given priority over fishers	82.4	89.5	85.4	81.0	97.9
4	Political influence	76.5	68.4	80.5	76.2	81.3
5	Poor law enforcement	88.2	94.7	87.8	85.7	83.3
6	Absence of extension services	29.4	26.3	34.1	52.4	27.1
4. Environmental		49.0	54.0	50.0	47.2	47.9
1	Declined fish stock	94.1	100.0	87.8	95.2	95.8
2	Loss of fishing habitats	58.8	47.4	26.8	14.3	37.5
3	Closure of inlet	100.0	100.0	97.6	100.0	97.9
4	Pollution of the lagoon	23.5	63.2	41.5	33.3	33.3
5	Pollution of the sea	11.8	47.4	39.0	4.8	39.6
6	Unpredictable weather	76.5	78.9	78.0	71.4	79.2
7	Salinity of water	52.9	36.8	36.6	47.6	14.6
8	Salinity of wind (<i>Lunu Kasuwa</i>)	41.2	42.1	43.9	14.3	43.8
9	Floods	76.5	36.8	34.1	57.1	54.2
10	Lightning	29.4	57.9	53.7	52.4	68.8
11	Tornados	17.6	31.6	48.8	66.7	8.3
12	Tsunami	5.9	5.3	12.2	9.5	2.1
5. Professional (Fishery related)		43.5	54.7	43.9	36.2	42.9
1	Destructive fishing methods	100.0	94.7	90.2	90.5	91.7
2	Market intruders	52.9	89.5	61.0	42.9	77.1
3	Objections for out migrations	23.5	36.8	36.6	23.8	18.8
4	General risks associated with fishing	17.6	21.1	7.3	9.5	6.3
5	Limited opportunities for traditional fishers	23.5	31.6	24.4	14.3	20.8
n		17	19	41	21	48

Note. Kuru = Kurusapaduwa; NW = North Weralabada; SW = South Weralabada; Ego = Egodawatta; Wera = Weralabada

Despite the respondents being from five different GNDs, a number of concerns are common to all and mentioned as high priorities. Of the five concerns that recorded the highest percentage values in each GND, three major concerns appeared to be common for all: closure of the inlet; variable income from fishing; and declined fish stock. Subsequently, when the ten most significant concerns for each GND were organised in order, five additional stressors were shown to be common for all GNDs in addition to the above three. They were: the cost of food; destructive fishing methods; poor law enforcement; bribery and corruption; and being abandoned as a community with farmers given priority over fishers. All ten major issues either belong to one of the four main sectors: economic; political; environmental; and professional, but not to the social sector (see Table 4.2). Overall, out of the first ten major concerns that recorded the highest percentages under each GND, eight were common to all five GNDs. The remaining ten major concerns in order were common among two or three GNDs.

Political influence was noted as a common concern for *South Weralabada* and *Egodawatta* whereas unpredictable weather was common for both *North Weralabada* and *South Weralabada*. The cost of children's education was among the ten most common stresses in *Kurusapaduwa*, *Egodawatta*, and *Weralabada* while negligence of authorities— notably through misplacement of documents was perceived as a high concern in *Weralabada*. Market intruders were perceived as one of the top ten major concerns in *North Weralabada* alone, whereas the cost of fuel for boats is placed as one of the ten major concerns only in *Kurusapaduwa*.

Market intruders are the ones who do not fish in Chilaw DS yet come and sell fish to the people in Chilaw. As fishers stated, these intruders are mainly intermediaries who sell second-rate or rotten fish to consumers at a very low price. Thus, the fishers cannot compete with them. However, there are five types of fish, *Hurulla*, *Matta Saalaya*, *Suudaya*, *Wella Suudaya*, and *Yak Saalaya*, that outsiders are banned from selling in Chilaw fish market, where the participants belong. These five types are the most commonly available fish in the sea of the study area. Nonetheless, these intruders come with small trucks, park them somewhere outside the market and conduct their business until they are warned off by the police. Although they have been taken into custody several times by the police after following tips from fishers in the area, the issue seems to

be recurring due to the political powers of the intruders and the prevailing bribery and corruption.

Close inspection of the major concerns also reveals that some were of great significance in particular GNDs. For example: land-related problems such as ownership of land; rejection by authorities of applications to add permanent structures to their houses; and encroachment were mainly confined to *Kurusapaduwa*, the GND bounded only on one side by a land mass and on all other sides by bodies of water. People from *Kurusapaduwa* were also worried about the loss of fishing habitats in the lagoon due to the difficulties faced by traditional fishers who still conduct their fishing operations there. The participants of *Egodawatta* in particular emphasised the need for having extension services for fishers to deal with issues such as declining fish stocks and the use of destructive fishing methods.

Overall, Figure 4.1 demonstrates that stresses related to economic and political sectors are respondents' highest priorities, while social attributes are their lowest. The perceived risk of economic aspects is deemed to be high compared to political issues for the respondents of *Kurusapaduwa*, *North Weralabada*, and *South Weralabada* while respondents of *Egodawatta* and *Weralabada* perceive political issues as the most important. Environmental related concerns are perceived as the third highest priority in each GND, except for *North Weralabada* where related professional concerns slightly surpassed that only by 0.7%.

Figure 4.1

Sector comparison of perceived major concerns of fishery households of each GND

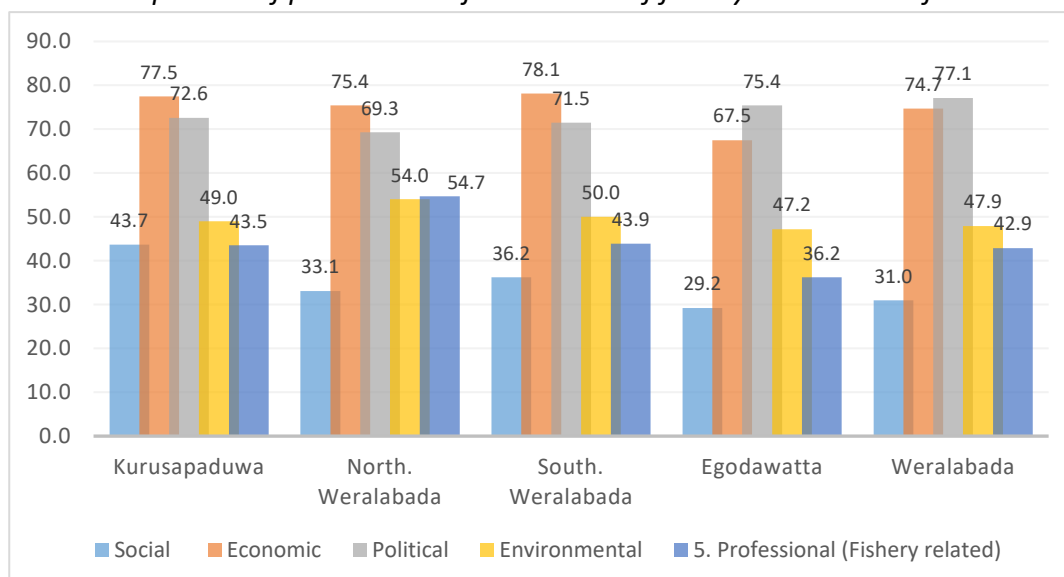


Figure 4.1 demonstrates a similar type of trend in each GND despite the slight differences, thus indicating all five GNDs identify or perceive similar concerns. The long bars for the political and economic sectors signify their contribution to shaping the livelihoods and lives of the respondents. By keeping environment-related stressors above the sectors of social and professional, they also convey the message that they are concerned about natural environment.

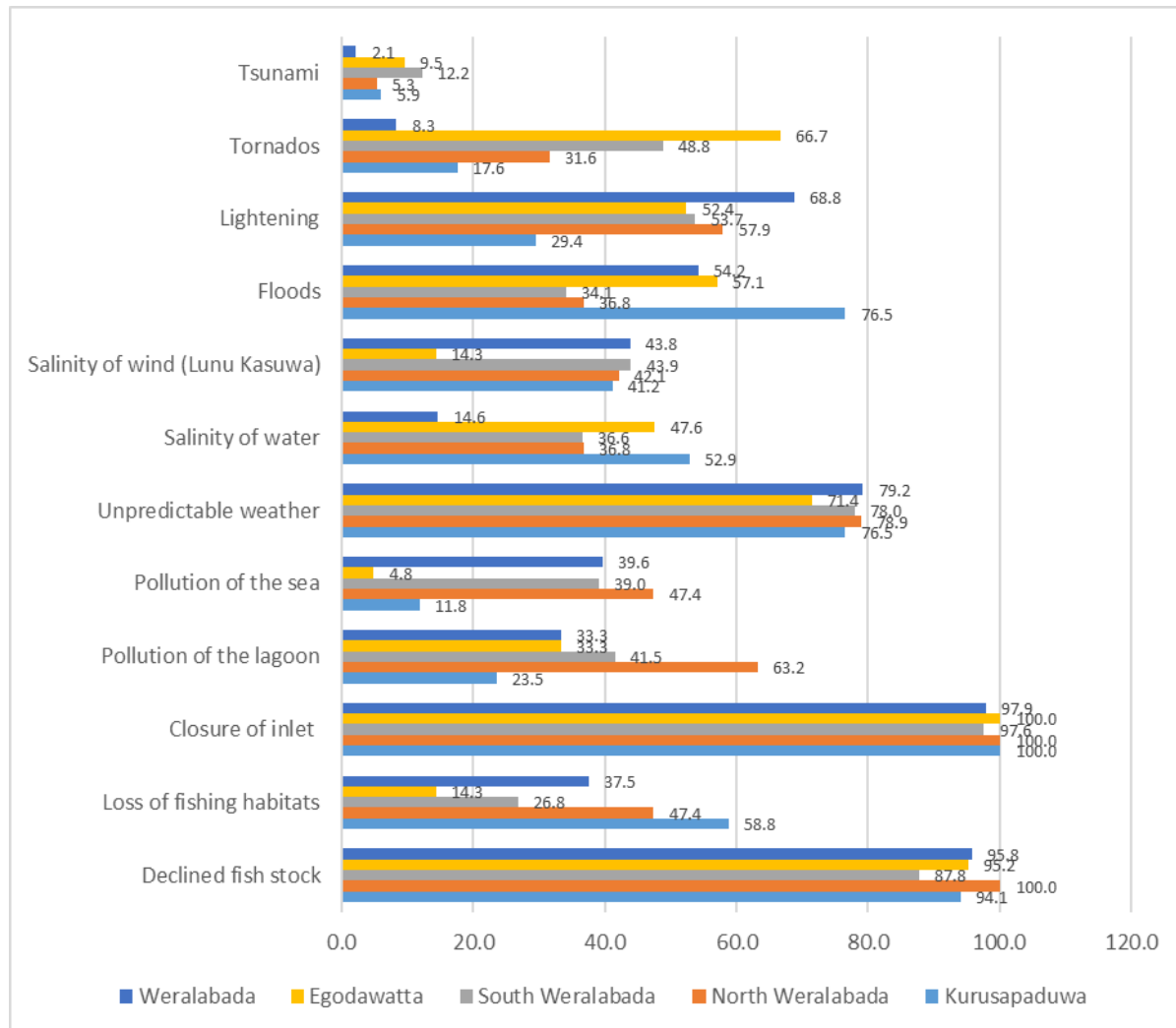
Subsequent examination of the types of environmental concerns among each GND is shown in Figure 4.2. The results clearly show that closure of the inlet and declining fish stocks are the main environmental concern for all GNDs. All participants of *Kurusapaduwa*, *North Weralabada*, and *Egodawatta* identified closure of the inlet as a major concern together with 97.6% of participants of *South Weralabada* and 97.9% of *Weralabada*. Similarly, 100% of *North Weralabada* participants and around 95% of those from *Weralabada* and *Egodawatta* marked declining fish stocks as a major concern while the recorded values for *Kurusapaduwa* and *South Weralabada* were 94.1% and 87.8%, respectively. Unpredictable weather was also claimed as a major distress by a high number of participants in each GND with the estimated values being: *Weralabada* – 79.2%; *Egodawatta* – 71.4%; *South Weralabada* – 78%; *North Weralabada* – 78.9%; and *Kurusapaduwa* – 76.5%.

In comparison to the four other GNDs, more *Kurusapaduwa* people reported suffering from loss of fishing habitats (58.8%), and floods (76.5%). Its geographical location could be a reason for these percentages. The respondents of *North Weralabada* demonstrated a keen interest in pollution with the highest recorded values for both the lagoon pollution (63.2%) and the pollution of the sea (47.4%). However, the majority (68.8%) of respondents who perceived lightning as a major threat were from *Weralabada* whereas *Egodawatta* revealed the highest percentage (66.7%) of people who were anxious about tornados. There was one death recorded in *Weralabada* related to lightning, whereas *Egodawatta* experienced two tornados occurring on the land without fatalities. There was an area in *Weralabada* which participants mentioned as a location subject to frequent lightning. Thus, both of these high percentages recorded for lightning and tornados in *Weralabada* and *Egodawatta* respectively, exemplified the influence of past experience on people's current perception. This was referred as the "risk experience appraisal" in the model of MPPACC of Grothmann and Patt (2005, p. 205). Tsunami was the natural disaster

of least concern. The respondents of *South Weralabada* showed the highest concern (12.2%) compared to other GNDs, for no apparent reason.

Figure 4.2

Perceived environmental concerns of fishery households of each GND



4.4 Prospects of Non-fishery Livelihoods

Views of people with non-fishery livelihoods were elucidated from government employees (clerks, and officers working at AGA), private sector employees (in garment and retail shops), self-employed people (sewing, driving taxi three wheelers, and working at food outlets), traders (grocery shops), and remittance earners. Trading and self-employment appeared to be the other most affected livelihoods after fishery, mainly because of their dependency on fishers' income. Table 4.3 summarises the major concerns listed by the group of people with non-fishery livelihoods.

Table 4.3*Perceived major concerns of the livelihood of non-fishery households*

Perceived as major concerns	Kuru	NW	SW	Ego	Wera
1. Social	34.4	46.4	50.0	37.5	50.8
1 Alcoholism	37.5	57.1	63.6	75.0	90.0
2 Ownership of land	12.5	28.6	18.2	0.0	13.3
3 Lack of mobility during a disaster	62.5	71.4	81.8	75.0	70.0
4 Regret and worry for being away from family & society	25.0	28.6	36.4	0.0	30.0
2. Economic	55.0	62.8	56.4	50.0	59.3
1 Variable income from fishing	62.5	28.6	45.4	50.0	50.0
2 Low wages	0.0	57.1	36.4	25.0	53.3
3 Cost of food	100.0	100.0	90.9	100.0	86.7
4 Cost of children's education	87.5	85.7	81.8	75.0	83.3
5 Difficulty in recovering money for the goods/services sold on credit	25.0	42.8	27.3	0.0	23.3
3. Political	67.5	59.0	70.9	75.0	76.0
1 Bribery and corruption	75.0	66.7	72.7	100.0	83.3
2 Negligence (misplacement of documents by government officials)	62.5	42.8	63.6	50.0	80.0
3 Abandoned as a community where farmers are given priority over coastal community	100.0	100.0	90.9	100.0	96.7
4 Political influence	37.5	57.1	81.8	75.0	63.3
5 Poor Law enforcement	62.5	28.6	45.4	50.0	56.7
4. Environmental	37.5	48.2	44.3	50.0	37.9
1 Declined fish stock	62.5	71.4	81.8	100.0	66.7
2 Pollution of the lagoon	87.5	100.0	90.9	75.0	76.7
3 Salinity of water	37.5	14.3	27.3	0.0	13.3
4 Salinity of wind ("Lunu Kasuwa")	37.5	28.6	9.1	0.0	20.0
5 Floods	25.0	14.3	18.2	25.0	36.7
6 Lightning	25.0	71.4	45.4	75.0	73.3
7 Tornados	12.5	57.1	54.5	75.0	6.7
8 Tsunami	12.5	28.6	27.3	50.0	10.0
n	8	7	11	4	30

Note. Kuru = Kurusapaduwa; NW = North Weralabada; SW = South Weralabada; Ego = Egodawatta; Wera = Weralabada

People in this category indicated a few major concerns related to the social sector (drugs, competition over wellbeing, and authorities' rejection of application to build

permanent protective structures such as a more concrete form of kitchen or a wall for protection against salty winds and encroachment of the beach and lagoon), as well in the environmental sector (loss of fishing habitats, closure of the inlet, pollution of the sea, and unpredictable weather) which were identified by the fishery group. The most understandable reason for the decrease in the environmental sector is that unlike the fishers, the non-fishery group is relatively independent of natural resources for their livelihoods. Alcoholism, and lack of mobility during a disaster emerged to be the social issues of most concern for all GNDs while the variable income from fishing, the cost of food, and cost of children's education appeared to be the most prominent economic issues common to many GNDs.

In relation to political aspects, all of *Kurusapaduwa*, *North Weralabada*, and *Egodawatta* participants stated that they felt left out, branded negatively as "coastal", while farmers were always highly regarded. This was also the case with *Weralabada* with the highest recorded value of 96.7% for the same statement. All residents of *South Weralabada* mentioned bribery and corruption as a top priority in relation to politics, while 81.8% of them also identified political influence as a major stressor.

However, when the major concerns were prioritised according to the percentage values regardless of the sectors, the top ten concerns include a mix of social, economic, political, and environmental issues. Accordingly, six stressors were recorded as common to all five GNDs among the first ten priority concerns that represent several sectors: lack of mobility during a disaster (social); cost of food (economic); cost of children's education (economic); feeling abandoned as a community when agricultural farmers are given priority over coastal communities (political); declining fish stocks (environmental); and pollution of the lagoon (environmental).

As expected, both fishery and non-fishery households perceived similar types of natural disasters as threats to the area although the non-fishery group did not repeat some of the fishers' major concerns related to the environmental sector as these are quite specific to fisheries. However, three specific major concerns related to social and economic sectors were added to the list by the non-fishery group, namely, regret and worry for being away from family and friends, low wages, and difficulty in recovering money for the goods/services sold on credit. Remittance earners in particular stated that their family members who work abroad are not happy and regret that they have to live away from

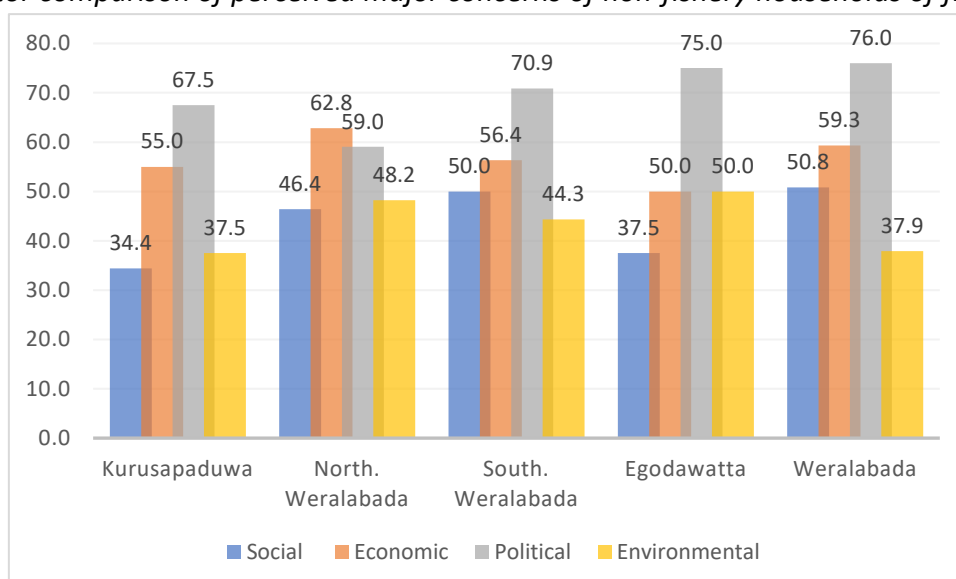
both family and friends despite gaining guaranteed income. I encountered several cases where some of them went abroad and came back as they could not live without family and friends. So, they finally gave that up as an option and decided to stay with their community doing the same job that they had been doing for years. This highlights the value these coastal communities place on the social bond they share over stability of income. According to a household of *Weralabada*:

Oh, I went to Dubai three times as a lathe machine operator. The first time stayed there months, second time six months and the last time I stayed there only for two months. I will not go there again. It is hard, you know. This is where we belong. No matter what, I will not leave here. (Household No of 41 of *Weralabada*)

Grocery shop owners, on the other hand, complained about the difficulty of recovering money for goods sold on credit. They stated that their business is largely dependent on the income of fishers. They usually lend goods to buyers and recover money in a defined period of time, such as a week, a month or on whatever the terms two parties agreed upon verbally. When fishers do not earn enough, the shop owners are not able to recover the debts. Many petty shops (very small grocery shops) have been forced to close down as a result. Yet, without their customers and the aforesaid business model, the grocery shop owners would not be able to run their businesses in the study area. Low wages were also added to the list by non-fishery income earners. Figure 4.3 compares and illustrates the overall sector comparison of five GNDs in relation to the group of non-fishery households.

Figure 4.3

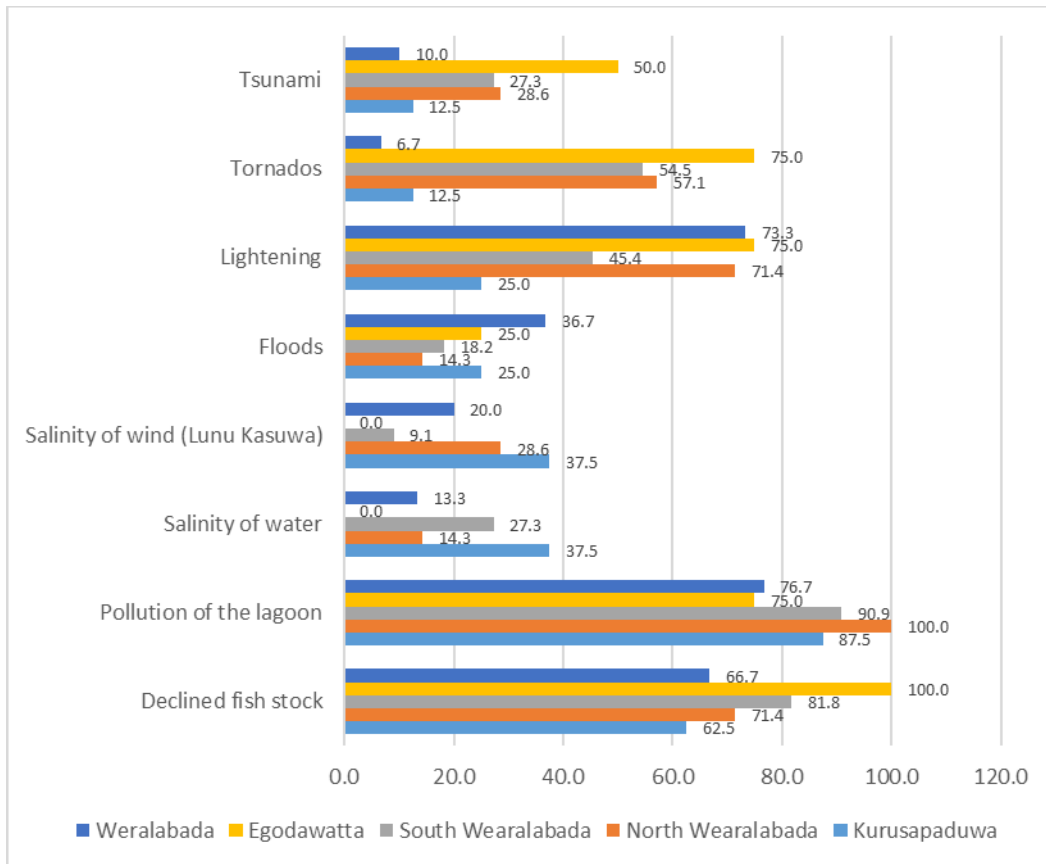
Sector comparison of perceived major concerns of non-fishery households of five GNDs



As presented in Figure 4.3, representatives of non-fishery households in all GNDs except for *North Weralabada* perceived political related concerns as the main stressors. For *North Weralabada* economic issues are of greatest concern. Economic threats were the second highest concerns for the communities of *Kurusapaduwa*, *South Weralabada* and *Weralabada*, whereas economic and environmental-related concerns are the most significant in *Egodawatta*. Surprisingly, *North Weralabada* participants identified economic concerns as lower priority, with political concerns considered to be the highest priority, followed by environmental concerns. In comparison to the views of fishers, the group of non-fishers seemed to take social issues more seriously, except for in *Kurusapaduwa* where it is the least pressing concern (34.4%). The priority each GND placed on environmental issues varies. *Kurusapaduwa*, *North Weralabada*, and *Egodawatta* consider these to be the third highest priority, while *South Weralabada* and *Weralabada* respondents assign the lowest priority to environmental concerns. These results therefore demonstrate the extra attention required for the non-fishery group in relation to environmental related programmes owing to their lower interest. This may be the result of their low level of dependence on natural resources for their livelihoods and immediate wellbeing. Figure 4.4 exemplifies the major concerns of the non-fishery group that each GND expressed in relation to the natural environment in which they live.

Figure 4.4

Perceived environmental concerns of non-fishery households



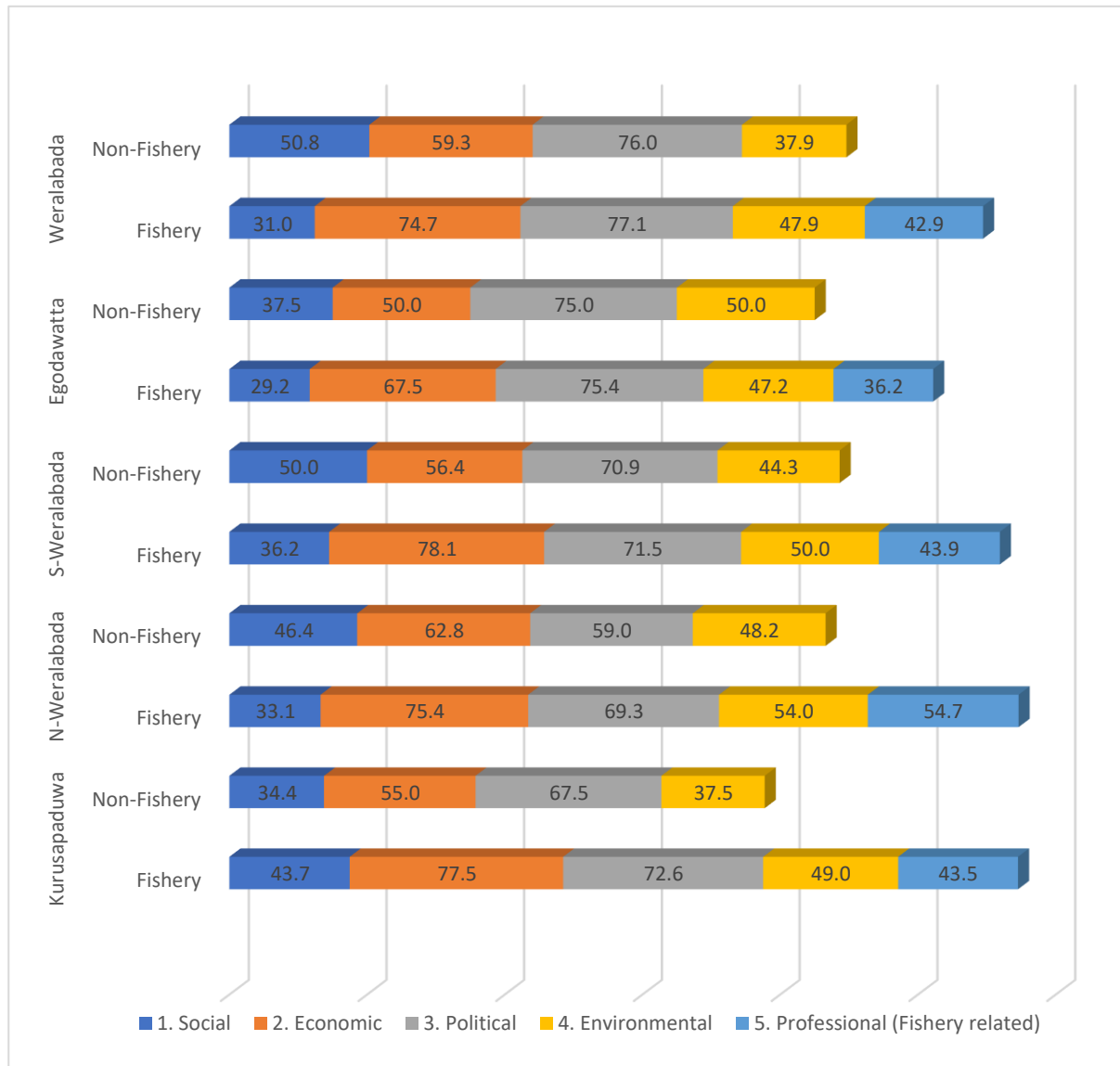
As shown in Figure 4.4, more than 60% of the respondents of all five GNDs commonly agreed that declining fish stocks and pollution of the lagoon are the major stressors for them. Lightning appeared to be a major stressor in *Weralabada*, *Egodawatta*, and *North Weralabada*. 75% of *Egodawatta* residents considered tornados as a major environmental issue. This was much higher than the perceptions of other GNDs. However, floods, salinity of water, salinity of wind, and tsunami did not seem to bother the majority of participants across all GNDs. The problem of salinity was raised as a constraint on maintaining a home garden when households were questioned about outside the food market for their survival.

Overall, there is little variation in the major concerns of both fishers and non-fishers (see Figure 4.5). Both groups seem to agree on common concerns as major distresses while some may have a slightly different view. For example, both fishery and non-fishery households in all GNDs commonly viewed political and economic related aspects as the most important matters while the non-fishery group of *Egodawatta* suggested

environmental issues were also significant, placing them as equal to the economic issues of concern. It is apparent that social issues were more highly regarded by non-fishers than fishers in all GNDs except for *Kurusapaduwa*.

Figure 4.5

Perceived major concerns of both fishery and non-fishery households

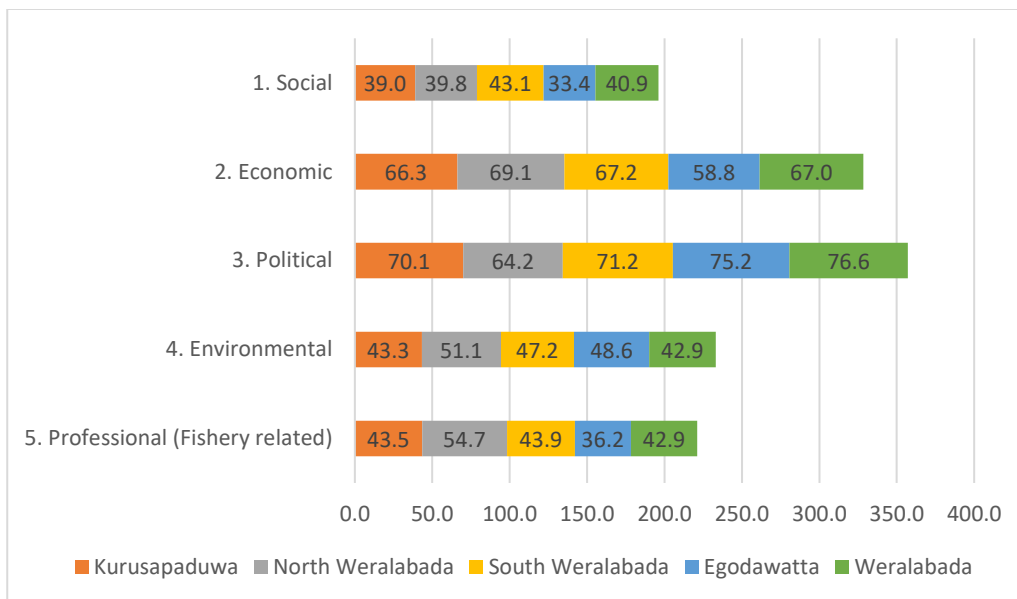


Note. N–Weralabada = North Weralabada; S–Weralabada =South Weralabada

Taken together, the results highlighted the interconnection between social, economic, political, and environmental issues alongside the matters specific to their line of work, fishery. Figure 4.6 demonstrates the collective perceived stressors of both groups of fishery and non-fishery of five GNDs that are organised into five sectors, social, economic, political, environmental, and professional.

Figure 4.6

Perceived major concerns (%) of all participants (both groups) in each GND



As shown in Figure 4.6, the community as a whole perceived political-related issues as the most important, whereas economic matters were perceived to be second. Interestingly, the majority of the community exhibited much more concern about their environmental-related matters than they did about social issues. Participants of *South Weralabada* and *Egodawatta* placed environmental-related matters even before the matters that are specific to fishing and its market while *Weralabada* participants gave them equal priority. The social-related matters appeared to be of least concern to all participants.

On the whole, these findings briefly introduce the context within which the study takes place and the position of environmental concerns encompassing the distressful changes in climate attributes among many other issues that these communities continue to battle. The following chapter continues the focus on livelihood specific concerns and addresses the first objective of the research which is to analyse the relative degree of livelihood vulnerabilities of the five coastal GNDs by means of an index.

Chapter 5. Results: Livelihood Vulnerability Index (LVI)

5.1 Introduction

The main purpose of this chapter is to provide an estimation of the relative vulnerabilities of the selected five coastal GNDs with the use of a Livelihood Vulnerability Index (LVI). Thus, it covers the first objective of the research which is to identify the extent to which coastal livelihoods are vulnerable to weather-related stresses and climate change impacts. For that, the composite LVI model of Hahn et al. (2009) is employed with contextual modifications. The index addresses livelihood vulnerability factors under eight major components or sectors. In addition to the overall LVI resulting from the analysis of these major sectors, the LVI within the framework of IPCC is also calculated to understand the exposure, sensitivity, and adaptive capacity of the selected five GNDs.

The chapter starts with a brief review of index construction where it elaborates both general and specific constituents of the approach, encompassing the reasons for the choice of the variables, or the way LVI is constructed. Next, the calculation of LVI is presented with the adapted formula. The scores produced for each GND on major components and their overall LVI are then presented, followed by the results of LVI within the framework of IPCC (LVI–IPCC) which categorises all major sectors into three main dimensions: exposure, sensitivity, and adaptive capacity.

5.2 Index Construction: Livelihood Vulnerability Index (LVI)

Cutter (2003) highlights the significance of conceptualising the most appropriate metrics followed by a minimum number of indicators that facilitate comparisons, an approach which is not apparent in contemporary vulnerability research. This section addresses this concern mainly in terms of type of indicators included in the analysis. Sullivan (2002) defines an index as “a statistical concept, providing an indirect way of measuring a given quantity or state, effectively a measure which allows for comparison over time” (p. 1201). It quantifies a phenomenon that is worth estimating, yet cannot be estimated directly (Sullivan, 2002), such as poverty and livelihood vulnerability. She argues that the construction of any index is a coming together of four main aspects: choice of components; sources of data; choice of formula; and choice of a base period (Sullivan, 2002) to all of which attention is given in this study.

Choice of components in this study is primarily based on a few sources: the model of LVI of Hahn et al. (2009); literature surveys; KIIs; the pilot survey; and participant observation. Within that, the aspects of relevance, representativeness, context specificity, and practicality of collecting the required data are considered. In particular, indicators are chosen to monitor vulnerability over time and space and to identify the circumstances in place that contribute to livelihood vulnerability. The index could therefore facilitate strategies aiming to reduce any realised vulnerabilities and be used to evaluate effectiveness of such strategies over time (Shah et al., 2013). Accordingly, LVI for the selected cases is derived from a combination of eight major components (also referred to as main sectors), namely: Natural Disasters, Climate Variability, Warnings, and Impacts (NDCVWI); Health (H); Food (F); Water (W); Shelter (S); Socio Demographic Profile (SDP); Livelihood Assets and Practices (LAP); and Socio-political Networks (SPN). Each of these comprises several subcomponents that demonstrate how the livelihoods of these communities are exposed and sensitive to nature-related distresses and the extent of their ability to recover from those. The elements of SLA are fused in these subcomponents to better understand the attributes of both “livelihood” and “vulnerability”. For example, the average dengue fever exposure prevention index demonstrates the level of human capital and financial capital of the household. Table 5.1 illustrates both the main components and subcomponents employed in the analysis together with a description, while Appendix A further illustrates their relationship to the original model and to referred sources. It is also important to note that the affairs that could mask or are not expressed by indicators are covered by the qualitative findings which are discussed at length in Chapter Seven of the thesis.

Table 5.1

Major components, subcomponents, and description of subcomponents of the Livelihood Viability Index (LVI) used to assess the relative vulnerabilities of five GNDs in Chilaw DS, Sri Lanka

Major components	Subcomponents	Description of subcomponents
Natural Disasters, Climate Variability, Warnings, and Impacts (NDCVWI)	Average no. of floods, tornados, cyclones, tsunamis, and thunderstorms in the last 6 years	Total no. of floods, tornados, cyclones, tsunamis, and thunderstorms that were reported by households in the last 6 years
	% of households affected by a natural disaster in any form	Percentage of households that reported any type of injury, death, or damage to their assets including all type of physical and financial assets
	Average no. of empty-handed fishing trips in the last month	Average of the total number of trips that each household made to the sea yet came back with insignificant or no harvest at all. A harvest that was not enough to sell is considered insignificant
	% of households that did not receive any disaster management training	Percentage of households that did not receive any type of disaster management training encompassing awareness training on warning signals and required behaviour during an emergency
	% of households who firmly stated they wouldn't obey warning signals	Percentage of households who are not willing to obey warning signals and go to a secure place during an emergency
	Mean standard deviation of monthly average of the average maximum daily temperature (years: 1983–2010)	Standard deviation of the average daily maximum temperature by month between 1983 and 2010 was averaged for Puttalam District
	Mean standard deviation of monthly average of the average minimum daily temperature (years: 1983–2010)	Standard deviation of the average daily minimum temperature by month between 1983 and 2010 was averaged for Puttalam District
	Mean standard deviation of monthly average precipitation (years: 1983–2010)	Standard deviation of the average daily minimum temperature by month between 1998 and 2003 was averaged for Puttalam District

Major components	Subcomponents	Description of subcomponents
Health (H)	% of households with a member suffering from a long term/recurrent disease	Percentage of households that report at least 1 family member with a chronic illness. Chronic illness was defined subjectively by the respondent as a disease that they have been suffering for a long time and for which they have been referred to a health clinic
	Average Dengue Exposure Prevention Index	Months reported exposure to dengue fever *Owning at least one bednet indicator (have bednet = 0.5, no bednet = 1) (e.g., Respondent reported dengue is a problem January–March and they do not own a bednet = 3*1 = 3).
	% of households who miss any of children's immunisation programmes funded by the government	Percentage of households who did not immunize their children. The households that missed the free of charge immunisation programme conducted by the government for the children is considered.
	% of households where a family member missed school or work due to illness in the last two weeks	Percentage of households who report at least 1 family member who had to miss school or work due to illness in the last 2 weeks.
	Average time to reach a health facility	Average time it takes the households to get to their chosen health facility.
	Average waiting time in the health facility	Average waiting time in the queue until a patient is examined by a health professional. This waiting time is usually short in Private Practices where a patient is charged a fee compared to the public hospitals that provide examination free of charge
	% of households with no proper garbage disposal service	Percentage of households who reported either they don't have a place to keep garbage or the ones that mention they cannot wait until municipal council comes and collects their garbage. The provincial council which is responsible for garbage collection often fails to adhere to the routine, thus there is practice of throwing garbage into the sea or lagoon
	% of households who have no access to water sealed/ring slab latrine	Percentage of households who have no water sealed/ring slab latrine. Water sealed latrine is safer and causes less health problems.
	Food (F)	Average no. of months households struggle to find food
% of households who totally depend on external market for their food (except for fish)		Percentage of households who obtain their food primarily from the outside markets except for fish.

Major components	Subcomponents	Description of subcomponents
	% of households who usually have two meals a day	Percentage of households who report that they have two or fewer than two meals a day. Two exceptions are the households who follow dietary requirements prescribed by a professional or the households who have chosen to reduce their meals to prevent weight gain.
	% of households with goitre or/and anaemia or/and night blindness	Percentage of households with goitre or/and anaemia or/and night blindness which reflects food utilisation of the household
	% of households with underweight children	Percentage of households with a child or children who is/are underweight due to malnourishment, which reflects food availability, accessibility, utilisation, and stability in the household
Water (W)	% of households without pipe borne water or water from their own natural resource, e.g., well or tube wells	Percentage of households not receiving water through the public water system or water from their own natural resources such as wells and tube wells
	% of households with no consistent water supply	Percentage of households who report that water is not available at their primary water source everyday
	Inverse of the average no. of litres of water stored per household per day (range: >0–1)	The inverse of (the average number of litres of water stored by each household + 1).
	% of households with the problem of saltwater intrusion	Percentage of households who reported that the water they have access to tastes salty thus cannot be drunk throughout the year or during some parts of the year
	% of households who buy drinking water from outside sellers/suppliers	Percentage of households who preferred to buy water from an outside seller. This constitutes three main groups: households with pipe-borne water, yet prefer to buy from the sellers, households with natural water resource, yet prefer to buy from outside sellers, and households who have no access to either type of water.
Shelter (S)	% of households who reside in illegal/unauthorised dwellings including houses in the buffer zone and bank of the lagoon	Percentage of households whose dwellings are built on government owned space including the buffer zone and the bank of the lagoon.

Major components	Subcomponents	Description of subcomponents
	% of households with coconut thatched roofed homes	Percentage of households with coconut thatched–roof houses.
	% of households without electricity	Percentage of households without electricity
	% of households who do not possess the deed of the land at the time of the interview	Percentage of households who claimed that they did not possess the deed of the land
Socio Demographic Profile (SDP)	Dependency Ratio	Ratio of the population under 15 and over 60 years of age to the population between 19 and 59 years of age.
	% of female headed households	Percentage of households where the primary adult is a female.
	Average age of female heads of household	Average of ages of female heads of households
	% of households in which the head of the household did not attend school	Percentage of households where the head of the household reports that they have attended 0 years of school.
	% of households with orphans	Percentage of households that have at least 1 orphan living in their home. Orphans are children <18 years old who have lost one or both parents
	% of households with members needing dependent care	Percentage of households with at least a member requiring assistance on his/her Activities of Daily Life (ADLs), because of age, physical or mental condition, illness or disability
	% of households who never participated in a skilled training (not relevant to fishing)	Percentage of households with family members who never have the chance to participate in any kind of skilled training organised by the government that could help them to find trained work, such as computer science and mechanics, other than fishing and related businesses
Livelihood Assets and Practices (LAP)	% of male headed households where housewives have recently started sharing the financial burden or/and in the process of finding ways for that	% of male-headed households where housewives have recently (during the last year) started sharing the financial burden or/are in the process of seeking livelihoods or employments, such as through asking politically or financially powerful people to find a job for them because of contemporary threats to the main livelihood. This trend could largely affect the overall wellbeing of the family where males can get addicted to alcohol and females may neglect care of their children's duties as well as their own wellbeing. The wages of women are claimed to be lower compared to men's. Thus, the social cost of this

Major components	Subcomponents	Description of subcomponents
		practice is assumed to outweigh its financial benefits (Ukwatta, 2010) which eventually increases their livelihood vulnerability.
	% of households without members working outside the community	Percentage of households who claim none of their family members work outside of the community for their primary work activity.
	Average Fishery Livelihood Diversification Index	The inverse of (the number of fishery and related livelihood activities +1) reported by a household, e.g., a household that fishes, raises livestock, and collects natural resources will have a Livelihood Diversification Index = $1/(3 + 1) = 0.25$
	% of households who do not own assets that they utilise for their livelihoods	Percentage of households who do not own assets that they utilise for their livelihoods
	% of households who rely on money lenders for their usual livelihood activities	Percentage of households who are in the cycle of getting money from money lenders at a very high interest rate for their livelihood activities. Thus, are unable to secure a considerable part of their income
	Average Occupational Diversity Index	The inverse of (the number of earning members of household +1)
Socio Political Networks (SPN)	Average Receive: Give ratio	Ratio of (the number of types of help received by a household in the past month + 1) to (the number of types of help given by a household to someone else in the past month + 1). This excludes any type of financial assistance.
	Average Borrow: Lend ratio	Ratio of a household borrowing money in the past month to a household lending money in the past month, e.g., if a household borrowed money but did not lend money, the ratio = 2:1 or 2 and if they lent money but did not borrow any, the ratio = 1:2 or 0.5.
	% of households who do not hold a membership in a Community Based Organisation (CBOs)	% of households who do not hold a membership in a Community Based Organisation (CBOs). CBOs are defined here as any form of society that is representative of the semi-formal financial sector such as Fisheries Cooperative Societies, women's society, Sarvodaya societies, women's societies belonging to Small Fisheries Federation,

Major components	Subcomponents	Description of subcomponents
		societies representative of any political party, funeral aid societies, societies formed by the Church, etc
	% of households that have not gone to their local government for assistance during the last 12 months	Percentage of households who have not asked their local government for assistance in the past 12 months. This includes visits to any of the government offices, encompassing AGA office, GN office, etc
	% of households who have never taken a loan from the formal banking sector	Percentage of households who have never taken a loan from the formal banking sector, excluding cooperative societies and insurance companies. Thus, this includes banks, leasing and finance companies regulated by central bank of Sri Lanka.
	% of households with members who could not secure an occupation due to political influence despite the qualifications they possess	Percentage of households with members that could not secure an occupation due to political influence despite the qualifications they possess
	% of households that did not vote during the last local election	Percentage of households with any of its eligible members not voting during the last local election held in September 2013

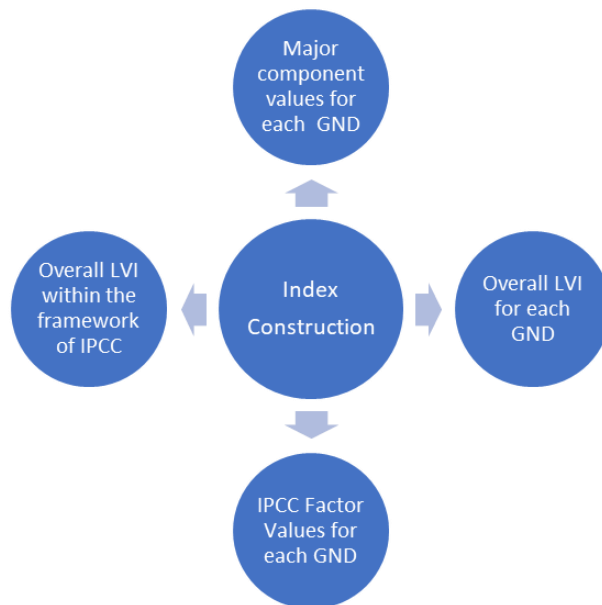
Note. Source: Author

In terms of sources of data, all fifty subcomponents except for climate variability variables (mean standard deviation of monthly average precipitation, mean standard deviation of monthly average of average maximum daily temperature, and minimum daily temperatures) were estimated using primary data. The secondary data acquired from the meteorology department of Sri Lanka was employed to calculate the aforementioned three climate-related indicators. The housing conditions were noted using the technique of participant observation, if the interview took place in the house. Otherwise, the participant was asked, and the answers often verified by observation during the field walks because all GNDs were situated very close to each other. Amarasinghe (2003) describes Sri Lankan fishing villages as “ribbon-like settlements” where many small houses of different types are located close together.

In all, the main components were employed in four different types of calculations as shown in Figure 5.1. The first was to see how each of these principal components (main sectors) that determine the overall livelihood vulnerability of each GND differs between the five GNDs. Then, they all were averaged for each GND to form the Livelihood Vulnerability Index (LVI) in order to understand the relative livelihood vulnerabilities. Thirdly, those major components were categorised under exposure, sensitivity, and adaptive capacity, the three main dimensions of the IPCC–S defined vulnerability (2001) to see how each GND differs in terms of its dimension of vulnerability. Finally, all three dimensions were combined to construct the relative livelihood vulnerability of each GND within the IPCC framework (LVI–IPCC). The detailed questionnaire which was used to gather primary data in this respect is presented in Appendix B.

Figure 5.1

Four types of computation that demonstrate differential livelihood vulnerabilities of the five GNDs



Note. Source: Author

In selecting sub-indicators, the three main dimensions of IPCC-defined vulnerability were considered in addition to their applicability to the eight major components of the LVI. Exposure is the combination of two main facets: the unit that is exposed and the hazard to which the unit is exposed. Scholars suggest that a unit should encompass recognisable assemblages of people and things they value, their attitudes plus the natural environment within which people live and support their existence (Easterling & Polsky, 2004; Turner II et al., 2003). It is not necessary to encompass all elements which exist

within the unit for an analysis, only the part of it which is bound by space and time (Polsky et al., 2007, p. 477). The livelihood capitals of households of the five coastal GNDs are thus considered as exposure units in this study, while the most common natural disasters including climate variability together with associated warnings and impacts constitute the hazard of concern. Accordingly, the chosen exposure variables here exemplify the frequency and severity of extreme events, variation in rainfall and temperature, and the level of disaster management plan in place, somewhat similar to the study conducted by Islam et al. (2014). In line with Hahn et al. (2009) and Islam et al. (2014), only retrospective values were considered on the premise that the higher the exposure the greater the propensity for the exposure unit to be impacted.

Sensitivity was determined by four main sectors or components. They were: health; food; water; and shelter. The selected variables or subcomponents symbolise the first order effects of the stress (Polsky et al., 2007). Smit and Wandel (2006) state that indicators of sensitivity often influence the system's adaptive capacity, thus there is a need to be more cautious in demarcating these in related studies. Therefore, I employed the variables of basic amenities such as health, food, water, and shelter that facilitate the absorption of impacts in the first place. These are the major sectors upon which relief programmes are often planned. The selection of the indicators of food was primarily guided by four key elements often discussed in relation to food shortage and famine: food availability; accessibility; utilisation; and stability. Shelter was discussed in relation to land tenure and housing conditions, the elements that the households considered most important for their well-being. The variables of health and water are also assessed for their availability, accessibility, and stability.

Adaptive capacity was measured using three main components: sociodemographic profile, livelihood assets and practices, and socio-political networks, which primarily exhibit the economic and socio-political strength of households to recover from impacts. Premised on the argument of Bohle et al. (1994), I claim that adaptive capacity to current climate impacts demonstrates an ability of the household to adapt to future impacts while it also adds to the knowledge of adaptation science.

Different households have different competencies and varying access to resources which in turn defines their capability to recover from a hazard. Thus, it is not just the intensity of the (external) hazard that determines their coping capacity but also the

endogenous factors or inherent capability of the household (Madhuri et al., 2014). This is defined as "the dualistic structure of vulnerability" by Wisner (2002, p. 17). Endogenous factors can be easily explained through the concept of livelihood capitals because lack of capitals often define the boundaries in adaptive capacity (Islam et al., 2014). Some indicators therefore were defined in the purview of capital assets. An example is access to the formal banking sector for credit facilities. Contrary to the approach of O'Brien et al. (2004), the range of technological options as a determinant of adaptive capacity was not considered in this context owing to the overexploitation that has already been in place in addition to natural disasters. In the event of decline in fish stock, technology aiming to exploit resources seems to be a problem rather than a solution. Socio-political capital, which contributes to increasing the adaptive capacity through social cohesion, was measured by three main indicators, including the average receive: give ratio used in the LVI; average borrow: lend ratio; and membership in Community-Based Organisations (CBOs) (Adger, 2000a; Leach et al., 1997).

Financial inclusion, which is a major part of inclusive growth, was also measured through the indicator of percentage of the households that have never taken a loan from a formal financial sector in addition to the financial supports granted by CBOs. It is defined by the Centre for Financial Inclusion as a "state in which everyone who can use them has access to a full suite of quality financial services, provided at affordable prices, in a convenient manner, with respect and dignity" (as cited in Arun & Kamath, 2015, p. 267). Similarly, the Commission on Growth and Development (CGD, 2008) describes inclusiveness as a concept that encompasses equity, equality of opportunity, and protection in market and employment transitions, thus it is an essential ingredient of any successful growth strategy. Owing to its significant contribution to job creation in addition to social and human development, the concept was largely recognised in the post-2015 agenda of the UN (Kelegama, 2014).

However, Brooks (2003) claimed the significance of considering not only endogenous but also exogenous factors in determining adaptive capacity as certain processes originating outside the system could inhibit its capacity to adapt. Therefore, in addition to variables that measure certain characteristics of households (e.g., reliance on money lenders for their livelihood activities) I included wider economic and political constitutes in formulating LVI, such as skill training available through the government and political

influence over finding an occupation. The measurements related to non-climatic factors (Fussler & Klein, 2006; Smit & Pilifosova, 2001) which Brooks (2003, p. 4) describes as generic determinants of adaptive capacity, such as economic resources, institutions, and equity, were also included while the hazard-specific factors were incorporated to measure exposure and sensitivity. All these indicators then were combined to generate the composite indexes we refer here as Livelihood Vulnerability Index (LVI) and LVI-IPCC.

Combining indicators into an index was guided by several methods (e.g., Eakin & Bojorquez-Tapia, 2008; Hahn et al., 2009; O'Brien et al., 2004; Sullivan et al., 2002; Sullivan & Meigh, 2005; Thornton et al., 2006; Vincent, 2004, 2007). Some employ equal weighted method while others rationalise their application of different weights to different components in the composite index. Counter to existing notions, Chen and Lopez-Carr (2015) state that the application of weights in VAs may not significantly impact vulnerability scores and ranking. In line with that and the application of Hahn et al. (2009), I employed a balanced and weighted approach for its simplicity and outreach, particularly in a resource-poor setting where climate change is proven still to be an abstract and distant concept. The section below elaborates on the computation of LVI together with its formula.

5.4 Index Computation

The computation of LVI and LVI-IPCC was guided by five major steps. They are explained below.

5.4.1 Transformation of Raw Data

Computation of LVI started with the transformation of the raw data into required measurement units or subcomponents, such as percentages and ratios while determining the minimum and maximum values to be used in step two. Table 5.2 presents these calculations.

Table 5.2

LVI subcomponent values and minimum and maximum subcomponent values for each GND

No	Major components and Subcomponents	Units	GNDs/Villages					Min	Max
			<i>Kuru</i>	<i>NW</i>	<i>SW</i>	<i>Ego</i>	<i>Wera</i>		
1	Natural Distresses, Climate Variability, Warnings and Impacts (NDCVWI)								
1.1	Average no. of floods, tornados, cyclones, tsunamis, and thunderstorms in the last 6 years	Count	4.48	3.12	2.87	3.36	3.23	0	5
1.2 a	% of households affected by a natural disaster in any form	Percent	64.00	42.31	26.90	60.00	35.9	0	100
1.3	Average no. of empty-handed fishing trips in the last month	Count	8.88	6.32	7.88	7.33	7.69	5	12
1.4	% of households that did not receive any disaster management training	Percent	68.00	46.20	50.00	56.00	37.18	0	100
1.5	% of households who firmly stated they wouldn't obey warning signals	Percent	92.00	78.77	86.50	88.00	88.46	0	100
1.6	Mean standard deviation of monthly average of average maximum daily temperature (years: 1983–2010)	Celsius	0.65	0.65	0.65	0.65	0.65	0.40	0.90
1.7	Mean standard deviation of monthly average of average minimum daily temperature (years: 1983–2010)	Celsius	1.10	1.10	1.10	1.10	1.10	0.30	3.10
1.8	Mean standard deviation of monthly average precipitation (from years: 1983–2010)	Millimetres	58.00	58.00	58.00	58.00	58.00	58.0	236.1
							0	0	0

No	Major components and Subcomponents	Units	GNDs/Villages					Min	Max
			Kuru	NW	SW	Ego	Wera		
2 Health (H)									
2.1	% of households with a member suffering from a long term/recurrent disease	Percent	28.00	23.10	19.23	20.00	15.38	0	100
2.2	Average Dengue Exposure Prevention Index	Months*Benet Indicator	6.30	4.60	4.35	5.27	3.21	0	12
2.3	% of households that miss any children's immunisation programmes funded by the government	Percent	0.00	0.00	0.00	0.00	1.28	0	100
2.4	% of households where a family member missed school or work due to illness in the last two weeks	Percent	16.00	23.08	15.38	28.00	8.97	0	100
2.5	Average time to reach a health facility	Minutes	25.20	18.04	22.69	16.48	29.17	15	35
2.6	Average waiting time in the health facility	Minutes	88.36	76.73	79.04	93.76	91.14	60	240
2.7	% of households with no proper garbage disposal service	Percent	48.00	38.46	40.38	52.00	14.10	0	100
2.8	% of households have no access to water sealed/ring slab latrine	Percent	20.00	38.46	30.77	32.00	20.51	0	100
3 Food (F)									
3.1	Average no. of months household struggle to find food	Months	6.04	5.77	5.15	5.52	5.45	3	7
3.2	% of households who solely depend on external market for their food (except for fish)	Percent	100.0	100.0	98.08	96.0	96.15	0	100
3.3	% of households who usually have two meals a day	Percent	80.00	73.10	75.00	84.00	67.90	0	100

No	Major components and Subcomponents	Units	GNDs/Villages					Min	Max
			Kuru	NW	SW	Ego	Wera		
3.4	% of households with goitre or/and anaemia or/and night blindness that reflects food utilisation	Percent	8.00	0.00	0.00	4.00	2.56	0	100
3.5	% of households with underweight children	Percent	12.00	7.69	11.54	12.00	14.10	0	100
4 Water (W)									
4.1	% of households without pipe borne water or water from their own natural resource i.e well or tube wells	Percent	12.00	15.38	13.46	20.00	19.20	0	100
4.2	% of households with no consistent water supply	Percent	16.00	19.20	23.10	5.80	26.90	0	100
4.3	Inverse of the average no. of litres of water stored per households per day (range: >0–1)	1/Litres	0.03	0.03	0.02	0.03	0.03	0.02	1.0
4.4	% of households with the problem of salt water intrusion	Percent	12.00	23.10	13.46	16.00	15.38	0	100
4.5	% of households that buy drinking water from outside sellers	Percent	40.00	53.80	48.10	36.00	16.67	0	100
5 Shelter (S)									
5.1	% of households that reside in illegal/unauthorised dwellings including houses in the buffer zone and bank of the lagoon	Percent	52.00	7.69	0.00	16.00	8.97	0	100
5.2	% of households with coconut thatched roofed homes	Percent	4.00	3.80	1.92	4.00	1.30	0	100
5.3	% of households without electricity	Percent	7.00	3.85	3.85	16.00	8.97	0	100

No	Major components and Subcomponents	Units	GNDs/Villages					Min	Max
			Kuru	NW	SW	Ego	Wera		
5.4	% of households that do not possess the deed of the land at the time of the interview	Percent	40.00	53.80	48.10	36.00	16.67	0	100
6 Socio Demographic Profile (SDP)									
6.1	Dependency Ratio	Ratio	0.49	0.39	0.35	0.52	0.40	0	6
6.2	% of female headed households	Percent	12.00	3.85	7.69	8.00	14.10	0	100
6.3	Average age of female headed household	1/Years	0.03	0.03	0.03	0.02	0.03	0.02	0.05
6.4	% of households that the head of the household did not attend school	Percent	8.00	7.70	9.62	0.00	1.28	0	100
6.5	% of households with orphans	Percent	8.00	0.00	0.00	0.00	7.70	0	100
6.6	% households with members needing dependent care	Percent	20.00	11.54	1.92	16.00	8.97	0	100
6.7	% of households who never participated in a skilled training (not relevant to fishing)	Percent	88.00	88.50	90.40	96.00	80.80	0	100
7 Livelihood Assets and Practices (LAP)									
7.1	% of male headed households where housewives have recently started sharing a financial burden or/are in the process of finding ways for that	Percent	92.00	85.60	90.40	92.00	41.00	0	100

No	Major components and Subcomponents	Units	GNDs/Villages					Min	Max
			Kuru	NW	SW	Ego	Wera		
7.2	% households without members working outside the community	Percent	84.00	80.80	84.60	92.00	71.80	0	100
7.3	Average Fishery Livelihood Diversification Index	1/# Fishery livelihoods	0.35	0.29	0.28	0.27	0.29	0.25	1.00
7.4	% of households that do not own assets that they utilise for their livelihoods	Percent	12.00	3.80	13.50	16.00	6.41	0	100
7.5	% of households who rely on money lenders for their usual livelihood activities	Percent	28.00	84.60	61.54	76.00	53.85	0	100
7.6	Average Occupational Diversity Index	1/# Occupations	0.42	0.42	0.43	0.39	0.44	0.25	1.00
8	Socio-political Networks (SPN)								
8.1	Average Receive: Give ratio	Ratio	1.88	1.48	1.00	1.27	1.07	0.38	5.00
8.2	Average Borrow: Lend ratio	Ratio	1.82	2.00	1.74	1.74	1.74	0.50	2.00
8.3	% of households that do not hold a membership in a Community Based Organisation (CBOs)	Percent	28.00	38.46	23.10	32.00	20.50	0	100
8.4	% of households that have not gone to their local government for assistance during last 12 months	Percent	24.00	61.50	21.20	48.00	30.80	0	100

No	Major components and Subcomponents	Units	GNDs/Villages					Min	Max
			Kuru	NW	SW	Ego	Wera		
8.5	% of households who has never taken a loan from the formal banking sector	Percent	12.00	19.23	7.69	28.00	16.67	0	100
8.6	% of households with members who could not secure an occupation due to political influence despite the qualifications they possess	Percent	32.00	38.50	34.60	28.00	33.30	0	100
8.7	% of households that did not vote during last local election	Percent	44.00	23.10	28.80	28.00	47.40	0	100

Note. Kuru = Kurusapaduwa; NW= North Weralabada; SW = South Weralabada; Ego = Egodawatta; Wera = Weralabada

5.4.2 Standardisation of Subcomponents

Step two involved standardisation of each subcomponent into an index using equation (1). The formula employed in the conversion of each indicator that carries different units of measurements into an index was similar to the one originally applied in the Human Development Index (HDI) to calculate the life expectancy index (United Nations Development Program [UNDP], 2007). A similar equation was applied by Hahn et al. (2009) to convert each indicator into an index in their calculation of LVI. This step was required to bring all subcomponents into one unit of measurement (“index value”) in order to make their amalgamation possible.

Equation 1

$$index_{s_d} = \frac{S_d - S_{min}}{S_{max} - S_{min}}$$

where s_d is the original subcomponent for village d , s_{min} and s_{max} are respectively the minimum and maximum values reported within all five villages. For example, the subcomponent of “average number of months household struggles to find food” ranged from 3 to 7 in the five villages we surveyed. For the variables that measure frequencies such as the “percentage of households without orphans” the minimum value was set at 0 and the maximum at 100. The variables are also set in such a way that each has a hypothetical positive relationship with overall livelihood vulnerability. For example, the increase in the “percentage of households without pipe-borne water” is assumed to increase the vulnerability. In certain circumstances the inverse of the crude indicator was included for example for “average fishery livelihood diversification index” and “average occupational diversification index” based on the assumption that livelihood vulnerability can be decreased by practising several livelihoods instead of relying solely on one or a few (please see Table 5.1 for ratio definitions). Using the same logic, the minimum and maximum values for those variables were transformed to be used in Equation (1). The derived standardised values termed as “index value” of each component are shown in Table 5.3.

5.4.3 Calculating the Value of Each Major Component

Next, the standardised subcomponents values (or indexed values) were averaged with the use of Equation (2) to generate the value of a main component.

Equation 2

$$M_d = \frac{\sum_{i=1}^n index_{s_{di}}}{n} \quad (2)$$

Where M_d = one of the eight major components for village d [Natural Disasters, Climate Variability, Warnings, and Impacts (NDCVWI), Health (H), Water (W), Food (F), Shelter (S), Socio Demographic Profile (SDP), Livelihood Assets and Practices (LAP), Socio Political Networks (SPN)] while $index_{s_{di}}$ represents the subcomponents, indexed by i , that make up each major component of the division d , and n is the total number of subcomponents that constitute each major component. Once the values of each major component for GNDs were calculated, the overall LVI of each GND was determined as in the following step. Table 5.3 demonstrates the overall sector value of each GND. For illustrative

purposes, a detailed example of calculating the Food major component for the LVI for one of the villages (*Kurusapaduwa*) of Chilaw DS is presented in Appendix C.

5.4.4 Calculating the Overall Livelihood Vulnerability Index (LVI) for Each Village

This step involved the calculation of the overall Livelihood Vulnerability Index (LVI) for each village either using equation 3 or 4, where all major components of the particular village were averaged.

Equation 3

$$LVI_d = \frac{\sum_{i=1}^8 w_{Mi} M_{di}}{\sum_{i=1}^8 w_{Mi}}$$

Equation 4

$$LVI_d = \frac{w_{NDCVWI} NDCVWI_d + w_H H_d + w_F F_d + w_W W_d + w_S S_d + w_{SDP} SDP_d + w_{LAP} LAP_d + w_{SPN} SPN_d}{w_{NDCVWI} + w_H + w_F + w_W + w_S + w_{SDP} + w_{LAP} + w_{SPN}}$$

where LVI_d , the Livelihood Vulnerability Index for division d , equals the weighted average of eight major components. The weight of each major component, w_{Mi} is determined by the number of subcomponents that make up each major component and were included to ensure that all subcomponents contribute equally to the overall LVI (Hahn et al., 2009; Sullivan et al., 2002). The results for the overall LVI of each GND are shown in Table 5.3. In this study, the LVI was scaled from 0 (least vulnerable) to 0.6 (most vulnerable). Appendix C further illustrates the calculation of LVI for *Kurusapaduwa*.

Table 5.3

Indexed values, major component values, and overall LVI for each village

No	Major components and Subcomponents	Sub component indexed values & major components values				
		Kurusapaduwa	N-Weralabada	S-Weralabada	Egodawatta	Weralabada
1	Natural Distresses, Climate Variability, Warnings and Impacts (NDCVWI)	0.577	0.427	0.443	0.497	0.447
1.1	Average no. of floods, tornados, cyclones, tsunamis and thunderstorms in the last 6 years	0.896	0.624	0.573	0.672	0.646
1.2	% of households affected by a natural disaster in any form	0.640	0.423	0.269	0.600	0.359
1.3	Average no. of empty handed fishing trips in the last month	0.555	0.188	0.411	0.333	0.384
1.4	% of households that did not receive any disaster management training	0.680	0.462	0.500	0.560	0.372
1.5	% of households who firmly stated they wouldn't obey warning signals	0.920	0.788	0.865	0.880	0.885
1.6	Mean standard deviation of monthly average of average maximum daily temperature (yrs: 1983-2010)	0.500	0.500	0.500	0.500	0.500
1.7	Mean standard deviation of monthly average of average minimum daily temperature (yrs: 1983-2010)	0.286	0.286	0.286	0.286	0.286
1.8	Mean standard deviation of monthly average precipitation (yrs: 1983-2010)	0.143	0.143	0.143	0.143	0.143
2	Health (H)	0.289	0.232	0.239	0.253	0.219
2.1	% of households with a member suffering from a long term/recurrent disease	0.280	0.231	0.192	0.200	0.154
2.2	Average Dengue Fever Exposure Prevention Index	0.525	0.383	0.363	0.439	0.268
2.3	% of households who misses any of children's immunisation programmes funded by the government	0.000	0.000	0.000	0.000	0.013
2.4	% of households where a family member missed school or work due to illness in the last two weeks	0.160	0.231	0.154	0.280	0.090
2.5	Average time to reach a health facility	0.510	0.152	0.385	0.074	0.708
2.6	Average waiting time in the health facility	0.158	0.093	0.106	0.188	0.173
2.7	% of households with no proper garbage disposal service	0.480	0.385	0.404	0.520	0.141
2.8	% of households have no access to water sealed/ring slab latrine	0.200	0.385	0.308	0.320	0.205
3	Food (F)	0.552	0.500	0.477	0.518	0.484
3.1	Average no. of months household struggle to find food	0.760	0.692	0.538	0.630	0.612
3.2	% of households who solely depend on external market for their food (except for fish)	1.000	1.000	0.981	0.960	0.962
3.3	% of households who usually have two meals a day	0.800	0.731	0.750	0.840	0.679
3.4	% of households with goitre or/and anaemia or/and night blindness that reflects food utilisation	0.080	0.000	0.000	0.040	0.026
3.5	% of households with under weight children	0.120	0.077	0.115	0.120	0.141
4	Water (W)	0.162	0.225	0.197	0.158	0.159
4.1	% of households without pipe borne water or water from their own natural resource i.e well or tubewells	0.120	0.154	0.135	0.200	0.192
4.2	% of households with no consistent water supply	0.160	0.192	0.231	0.058	0.269
4.3	Inverse of the average no. of litres of water stored per household per day (range: >0-1)	0.011	0.010	0.001	0.011	0.013
4.4	% of households with the problem of salt water intrusion	0.120	0.231	0.135	0.160	0.154
4.5	% of households that buy drinking water from outside sellers/suppliers	0.400	0.538	0.481	0.360	0.167
5	Shelter (S)	0.258	0.173	0.135	0.180	0.090
5.1	% of households who reside in illegal/unauthorised dwellings including houses in the bufferzone and bank of the lagoon	0.520	0.077	0.000	0.160	0.090
5.2	% of households with coconut thatched roofed homes	0.040	0.038	0.019	0.040	0.013
5.3	% of households without electricity	0.070	0.038	0.038	0.160	0.090
5.4	% of households who do not possess the deed of the land at the time of the interview	0.400	0.538	0.481	0.360	0.167
6	Socio Demographic Profile (SDP)	0.270	0.212	0.224	0.190	0.215
6.1	Dependency Ratio	0.082	0.064	0.058	0.087	0.067
6.2	% of female headed households	0.120	0.038	0.077	0.080	0.141
6.3	Average age of female heads of household	0.445	0.303	0.413	0.042	0.313
6.4	% of households whose head of the household did not attend to school	0.080	0.077	0.096	0.000	0.013
6.5	% of households with orphans	0.080	0.000	0.000	0.000	0.077
6.6	% households with members needing dependent care	0.200	0.115	0.019	0.160	0.090
6.7	% of households who never participated in a skilled training (not relevant to fishing)	0.880	0.885	0.904	0.960	0.808
7	Livelihood Assets and Practices (LAP)	0.421	0.472	0.464	0.497	0.338
7.1	% of male headed households where housewives have recently started sharing a financial burden or/and in the process of finding ways for that	0.920	0.856	0.904	0.920	0.410
7.2	% of households without members working outside the community	0.840	0.808	0.846	0.920	0.718
7.3	Average Fishery Livelihood Diversification Index	0.138	0.056	0.044	0.033	0.048
7.4	% of households who do not own assets that they utilise for their livelihoods	0.120	0.038	0.135	0.160	0.064
7.5	% of households who rely on money lenders for their usual livelihood activities	0.280	0.846	0.615	0.760	0.538
7.6	Average Occupational Diversity Index	0.227	0.231	0.241	0.187	0.251
8	Socio-Political Networks (SPN)	0.372	0.435	0.302	0.380	0.352
8.1	Average Receive: Give ratio	0.325	0.239	0.135	0.193	0.150
8.2	Average Borrow: Lend ratio	0.880	1.000	0.827	0.827	0.825
8.3	% of households who do not hold a membership in a Community Based Organisation (CBOs)	0.280	0.385	0.231	0.320	0.205
8.4	% of households that have not gone to their local government for assistance during last 12 months	0.240	0.615	0.212	0.480	0.308
8.5	% of households who have never taken a loan from the formal banking sector	0.120	0.192	0.077	0.280	0.167
8.6	% of households with members that could not secure an occupation due to political influence despite the qualifications they possess	0.320	0.385	0.346	0.280	0.333
8.7	% of households that did not vote during last local election	0.440	0.231	0.288	0.280	0.474
		Kurusapaduwa	N-Weralabada	S-Weralabada	Egodawatta	Weralabada
	Overall LVI	0.371	0.339	0.317	0.341	0.298

Note. N–Weralabada = North Weralabada; S–Weralabada = South Weralabada Source:

Author

5.4.5 Calculating LVI–IPCC: Incorporating the IPCC–Defined Three Dimensions

Similar to Hahn et al. (2009), we alternatively estimated livelihood vulnerability of each village within the framework of IPCC. For that, the same eight main components or sectors were categorised under each dimension of the IPCC-defined vulnerability, exposure, sensitivity, and adaptive capacity (Table 5.4).

Table 5.4

Main components of vulnerability that constitute each IPCC contributing factor

IPCC Contributing Factors	Vulnerability Main Components/Sectors
Exposure	Natural Disasters, Climate Variability, Warnings, and Impacts
Sensitivity	Health
	Food
	Water
	Shelter
Adaptive Capacity	Socio-demographic Profile
	Livelihood Assets and Practices
	Socio-political networks

Note. Source: Author

Exposure was measured by the main component of Natural Disasters, Climate Variability, Warnings, And Impacts (NDCVWI) that incorporates natural disasters and climate variability together with warning systems in place and their effectiveness. The computation of adaptive capacity was comprised of three main components: Socio-Demographic Profile (SDP), Livelihood Assets and Practices (LAP) and Socio-political Networks (SPN). However, it is required to take the inverse of the respective subcomponents in calculating the adaptive capacity as it is negatively correlated with vulnerability unlike the overall LVI calculated above. For example, instead of using “percentage of female headed households”-we need to use “percentage of male headed households” in deriving values for the dimension of adaptive capacity. Sensitivity which demonstrates the extent of the absorption capacity of the system is estimated using four main components: health (H), food (F), water (W), and shelter (S). Before merging, each contributing factor value is estimated using the following formula:

Equation 5

$$CF_d = \frac{\sum_{i=1}^n w_{M_i} M_{di}}{\sum_{i=1}^n w_{M_i}}$$

where CF_d is an IPCC–defined contributing factor (exposure, sensitivity, or adaptive capacity) for the village d , M_{di} are the major components for division d indexed by i , w_{M_i} is the weightage of each major component, and n is the number of major components in each contributing factor (Hahn et al., 2009).

Once the three contributing factors were calculated they were combined using the following:

Equation 6

$$LVI - IPCC_d = (e_d - a_d) * s_d$$

where $LVI - IPCC_d$ is the LVI for division d expressed using the IPCC vulnerability framework, e is the calculated exposure score for division d (equivalent to the Natural Disasters, Climate Variability, Warnings and Impacts major component), a is the calculated adaptive capacity score for division d (weighted average of the Socio-demographic Profile, Livelihood Assets and Practices, and Socio-political Networks major components), and s is the calculated sensitivity score for division d (weighted average of the Health, Food, Water, and Shelter major components). I scaled the LVI–IPCC from –1 (least vulnerable) to 1 (most vulnerable). Table 5.5 shows the calculated values of LVI–IPCC for each GND.

Table 5.5

Contributing factor values and LVI–IPCC values of five GNDs

Contributing Factors	Kurusapaduwa	N–Weralabada	S–Weralabada	Egodawatta	Weralabada
Exposure	0.577	0.427	0.443	0.497	0.447
Sensitivity	0.314	0.281	0.264	0.278	0.242
Adaptive Capacity	0.554	0.547	0.590	0.569	0.610
LVI–IPCC	0.0074	–0.0339	–0.0387	–0.0201	–0.0395

Note. N–Weralabada = North Weralabada; S–Weralabada = South Weralabada Source:

Author

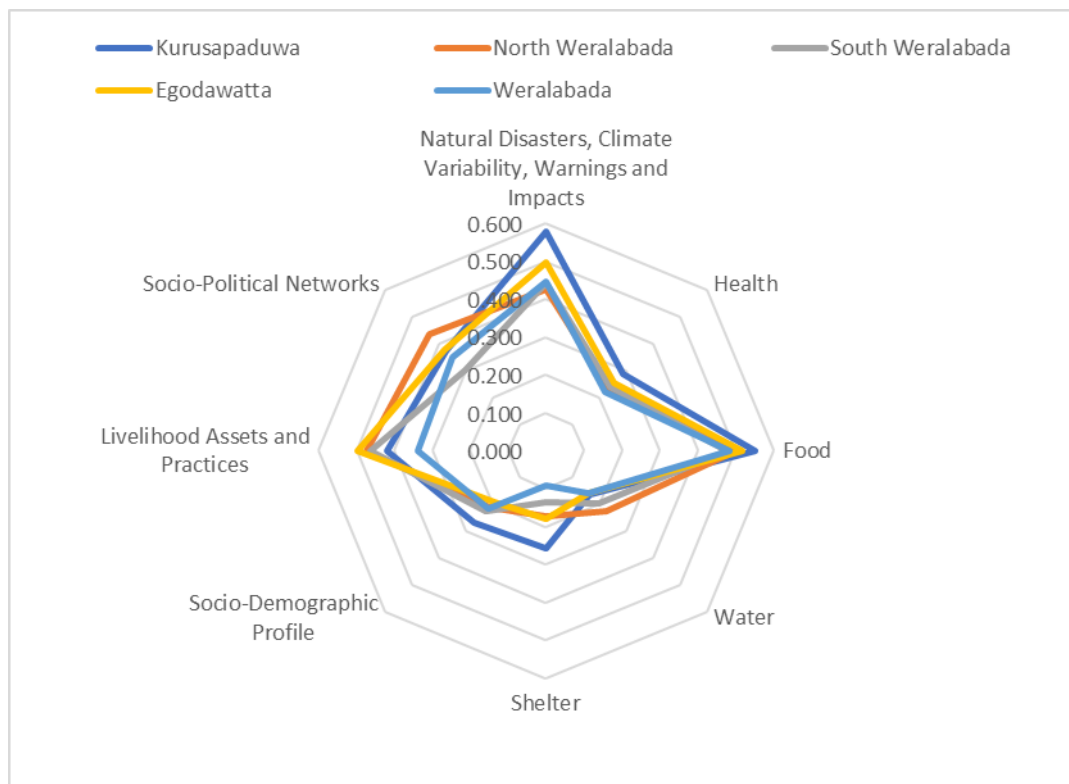
A detailed example of calculating the contributing factors of the LVI–IPCC for one of the five GNDs (*Kurusapaduwa*) is presented in Appendix D. The following sections discuss the results of the computations under two main themes: relative sector (major component) vulnerability scores and overall livelihood vulnerability index of GND (LVI).

5.5 Relative Sector Vulnerability Scores

This section elaborates the result of sector vulnerabilities which was defined based on number of subcomponents (Table 5.2 and Table 5.3). Each subcomponent was constructed in a way that its increase would increase the value of the major component and then the livelihood vulnerability. In other words, they shared a direct relationship where if one increases, the other one also increases. For example, when the variable of “average time to health facility increases” the major component “health” and “livelihood vulnerability” increases subsequently. Figure 5.2 illustrates the variability of the sector values for each village.

Figure 5.2

Main sector values in each GND (spider diagram of vulnerability)



Note. Source: Author

The first main component is Natural Disasters, Climate Variability, Warnings, and Impacts (NDCVWI) which is comprised of eight subcomponents. The highest value for this contributing factor was in *Kurusapaduwa*, where 64% of the respondents reported that they were victims of natural disasters that took place in the area, while 68% of the same respondents stated that they never received any kind of formal disaster management training other than asking them to evacuate the place when warning signals are in place. 92% of them firmly stated they would not leave their homes during an emergency in the future. This value remains high (above 85%) for all the other villages excluding *North Weralabada* which recorded the lowest value of 79% in that regard. The lowest average of empty-handed fishing trips was also recorded by *North Weralabada* (6.32). In effect, *Kurusapaduwa* was found to be the most vulnerable in terms of natural disasters, climate variability, warnings, and impacts with the value of 0.577 while *North Weralabada* accounted for the lowest value (0.427).

The second major sector of concern is health and that also consists of eight subcomponents. Each village recorded an average value of less than 30 minutes as the time they spend to travel to a health facility while the highest and lowest durations were recorded by *Weralabada* (29.17 minutes) and *Egodawatta* (16.48 minutes), respectively. The main reason for this is that the District General Hospital of Chilaw⁶, attended by the participants who chose to visit government service, is located in the city close to the study area. In addition, a few private health clinics operate in the area where the people who can afford a consultation often choose to visit for short-term illnesses. Usually, doctors who work in private clinics refer their patients to Chilaw Hospital or any other government hospital specialising in the area of concern if it is necessary, depending on the seriousness of the illness and the patient's financial capacity. Similarly, the average waiting time in a health facility, which ranges from 76.73 to 93.76 minutes, reflects the type of health service residents often attend because private clinics are believed to offer quicker service than the government hospital offers. However, in the respondents' view, this is related to profit maximisation, rather than to the quality of the service of such private clinics. By quality they meant the time that the doctor spends with the patient and to what extent they felt comfortable in explaining their situation. This however seemed worse in the

⁶ The Ministry of Health of Sri Lanka rank its hospitals based on the facilities each delivers to its patients. Accordingly, 10 levels exist whereas the hospital of Chilaw is in the fourth place with quite a large range of health facilities. (MOH, 2021).

government hospital where the majority claimed that they were not treated with respect by its staff, except for a few personnel they named.

The lowest percentage of households with a member who suffers from long-term recurrent diseases (chronic illness) was recorded by *Weralabada* (15.38%) while the highest was recorded by *Kurusapaduwa* (28%). The other three GNDs noted a percentage that varies from 19.23% to 23.10%: *South Weralabada* (19.23%), *Egodawatta* (20.0%) and *North Weralabada* (23.10%). *Weralabada* accounted for the lowest percentage of 8.97 for the households with a family member's loss of school or work due to illness although it was the only GND with respondents (1.28%) who missed children's immunisation. All the other four GNDs were up to date in that regard, thus recorded a zero value for missed immunisation.

Compared to the other four GNDs, *Weralabada* seemed to have a proper garbage disposal service with its lowest value being 8%, whereas *Egodawatta* and *Kurusapaduwa* recorded considerably higher percentages of 52 and 48 respectively. The lowest values of 20% and 20.51% of households that had no access to water-sealed latrines were recorded by *Kurusapaduwa* and *Weralabada*, respectively, while the highest of 38.46% was reported by *North Weralabada*. Approximately one-third of the participants of *South Weralabada* (30.77%) and *Egodawatta* (32%) also confirmed that they did not have access to water-sealed latrines. *Kurusapaduwa* recorded the highest index value of 6.3 in relation to the average dengue fever prevention index, almost twice the lowest value (3.21) recorded by *Weralabada*. Subsequently, when the subcomponents were combined, *Kurusapaduwa* recorded the highest value for health sector vulnerability while the lowest was recorded in *Weralabada*. The GNDs of *North* and *South Weralabada* did not show much variation in that regard where the former recorded a value of 0.232 while the latter accounted for 0.239.

The five subcomponents are combined to generate the value for the third sector, food vulnerability. The average number of months households struggled to find food varied from between 5.15 (*South Weralabada*) to 6.04 (*Kurusapaduwa*). As the salt-filled wind (*Lunu Kasuwa*) does not permit GNDs to maintain home gardens without significant effort, they must buy all their food except fish from external markets. This near total dependency on outside sources of food required the households to have sufficient income to maintain their food security. Therefore, there is a direct link with their livelihood, especially because

saving food for difficult times is not a common practice in any of these villages. In other words, threats to livelihoods straightaway jeopardise their food security.

All respondents from *Kurusapaduwa* and *North Weralabada* stated that they depend entirely on the outside market for their food while 98% of the participants from *South Weralabada* and approximately 96% from both *Egodawatta* and *Weralabada* indicated the same dependency. About one fifth of the respondents of *Kurusapaduwa* and *Egodawatta* reported having two meals a day whereas three-quarters of the households of *North* and *South Weralabada* were similarly placed. The lowest percentage of 67.90 was recorded by *Weralabada* in that regard even though they had the highest percentage of underweight children (14.10%), which suggested an intervention by the health department. Illnesses related to food utilisation such as goitre, anaemia, and night blindness were common among the residents of *Kurusapaduwa*, which recorded the highest percentage of 8, whereas *Egodawatta* recorded just a half of that value (4%). None of the respondents in *North Weralabada* and *South Weralabada* suffer from any of the above food-related illnesses while 2.5 % of the respondents from *Weralabada* reported having at least one of those diseases. Overall food vulnerability across GNDs does not exhibit much of a variation with *South Weralabada* recording the lowest value of 0.477 while the highest of 0.552 was documented by *Kurusapaduwa*.

Water, the fourth main component, like the food sector, consists of five subcomponents. About 80% of the respondents of all GNDs have access to pipe-borne water either from their natural resources or from the government water supply scheme. Yet a certain group of residents still prefer to buy water from outside sellers who come and sell water in the study area. This is in addition to the households that do not have access to pipe-borne water and natural water resources of their own.

53.80% of *North Weralabada* residents, 48.10% of *South Weralabada* residents, and 40% of *Kurusapaduwa* residents buy water from the outside suppliers while for *Egodawatta* that rate was lower at 36%. *Weralabada* noted the lowest percentage of 16.67 in that regard owing to the doubts households there have about the quality of the water brought in bowsers by those sellers. They believe it is the taste of the water that attracts the residents rather than belief about the quality of the water. It is just a trend that people follow for no apparent reason. This suggests the need for involvement of the

Public Health Inspector (PHI) of the area to assure the quality of the water brought by outside suppliers.

The households of *Weralabada*, *Kurusapaduwa*, *North Weralabada*, and *Egodawatta* recorded that they store on average of 33 litres per day, while the highest of 50L was recorded by *South Weralabada*. The lowest percentage in that regard was recorded by *Egodawatta* (5.8%) in contrast to its highest percentage of households (20%) with no access to pipe-borne water. The households who have no access to pipe-borne water commonly obtain water from their neighbours for drinking, cooking, and even sometimes for bathing purposes. This practice seemed most prevalent in *Egodawatta* which justifies the contrasting ratios identified above. Even though salinity of water is stated as an environmental problem for the GNDs bordering the sea, some of the participants managed to overcome saltwater intrusion through means that might affect their drinking water particularly. They managed either to get access to government water supply schemes or to have access to family and friends' natural sources that were not affected by saltwater intrusion. As mentioned above, some households also buy water from outside sellers. Despite the cost this involves, many do not consider it a problem as long as there is continuous supply. When all the subcomponents were combined, the highest (0.225) and the lowest (0.158) water vulnerability were recorded for *North Weralabada* and *Egodawatta*, respectively. The second highest of 0.197 was recorded for *South Weralabada* whereas for *Kurusapaduwa* it was calculated as 0.162. In that respect, *Weralabada* was very similar to *Egodawatta*, having the second lowest water vulnerability with a value of 0.159.

Shelter, which is the fifth major component, was not included in the original model of Hahn et al. (2009), nor were any of its subcomponents. Yet, during KIIs, FGDs, and the pilot survey it was revealed that land tenure and the condition of dwellings had been a major concern in the area for a long time, thus shelter was included as a separate sector in the calculation of LVI. The shelter component consists of four subcomponents: percentage of households that reside in illegal/unauthorised dwellings including houses in the buffer zone and bank of the lagoon; percentage of households with coconut thatched homes; percentage of households without electricity; and percentage of households that did not possess the deed of the land at the time of the interview. Noticeably, a significant number

of dwellings were reported to be located in either the buffer zone or on the bank of the lagoon, especially in the cases of the households of *Kurusapaduwa* and *Egodawatta*.

More than half (52%) of the *Kurusapaduwa* residents stated that their dwellings are considered illegal while the second highest percentage of illegal dwellings (16%) was recorded by *Egodawatta* which borders the lagoon on one side. The households complained that this situation prevented them from further development of their houses, thus impacting their wellbeing. 40% of *Kurusapaduwa* and 36% of *Egodawatta* households claimed that they do not possess a deed at present, thus were unable to declare their wealth when required by formal banks for loan approvals. Conversely, none of the participants in *South Weralabada* had the problem of non-legitimate construction, so they presumed that they all resided in legal dwellings even though 48.10% of them stated that they did not possess the title deed to the land. Only a small percentage was reported to have coconut thatched homes. This statistic remained below 4.1% for all GNDs. The majority of the households in all five villages had an electricity facility while the highest proportion of 16% of households without electricity were in in *Egodawatta*. Overall, the shelter vulnerability index was highest in *Kurusapaduwa* (0.258) followed by *Egodawatta* (0.180). The lowest shelter vulnerability of 0.090 was reported by *Weralabada*.

Socio-demographic Profile (SDP) constituted of seven subcomponents, is the sixth main component of the LVI. As in the previous case, *Kurusapaduwa* recorded the highest vulnerability index of 0.270 for SDP. The remaining index values of SDP vary between 0.224 and 0.190. In order of high to low they were: *South Weralabada* (0.224); *Weralabada* (0.215); *North Weralabada* (0.212); and *Egodawatta* (0.190). Obvious reasons for *Kurusapaduwa* having the highest vulnerability on SDP seem to be the highest values recorded under the subcomponents of average age of female headed households (0.445); percentage of households with orphans (8%); and percentage of households with responsibility for caring for dependent members (20%). Additionally, *Kurusapaduwa* claimed the second highest value of all other subcomponents, except for the variable of percentage of households that never participate in skilled training. This includes the dependency ratio (0.49), percentage of female headed households (12%), and percentage of households that the head of did not attend school (8%). The zero percent for both subcomponents of households with orphans and head of the households who did not attend school, together with its lowest value for average age of female headed

households (0.02) obviously lowered the overall sector vulnerability of SDP of *Egodawatta*.

The seventh major sector, Livelihood Assets and Practices (LAP) is comprised of six subcomponents. More than 70% of households in each village reported that they do not have a member who works outside the community. Unlike Hahn et al. (2009), who relate this ratio with the infection of HIV in the context where they tested the model, I considered that the higher the number of people who work outside the community the lower their vulnerability would become, mainly owing to certainty of income. Almost all members of this group (who are employed outside the study area) either work abroad or near the villages as salaried employees, thus have considerable job security which is independent of the natural disasters that the coastal communities often encounter. The highest percentage of 92 was recorded by *Egodawatta* while the lowest was recorded by *Weralabada* (71.8%)—the same village that recorded the highest percentage of members working abroad. In relation to ownership of assets, in *Egodawatta* (16%) do not own the assets they use for their livelihoods, the highest of the five GNDs, and 76.0% of the *Egodawatta* households also claimed to rely on money lenders for their usual livelihood activities. 92% of households in *Egodawatta* and *Kurusapaduwa*, the highest statistic, stated that women, mainly the housewives, recently started to shoulder the financial burden when the male partner was not able to meet the basic needs of the households due to poor fishing harvest.

Livelihood diversification, which largely determines the vulnerability of LAP, was measured using two indexes: average fishery livelihood diversification index and average occupational diversification index. The former is obviously related to fishery and fishery-related livelihood activities while the latter considers all types of income sources of household members. We calculated those indicators in such a way that a high score of each indicator reflects high vulnerability (see Table 5.1). Accordingly, the highest value for the former was recorded in *Kurusapaduwa* (0.35) while the lowest was recorded in *Egodawatta* (0.27). *Weralabada* and *North Weralabada* recorded the same value of 0.29 while *South Weralabada* noted a slight decrease with a value of 0.28. The average occupational index generated different values to that of the fishery livelihood vulnerability index, consequently, the highest vulnerability was recorded in *Weralabada* (0.44) while the lowest was recorded in *Egodawatta* (0.39). In this case, both *Kurusapaduwa* and *North*

Weralabada shared the same value of 0.42 while for *South Weralabada* it was 0.43. Each of these index values however does not demonstrate much of a variation between the five villages, thus probably not impacting on the variations of the overall LAP vulnerability index. All those highest values for the six subcomponents of LAP, despite the variables associated with livelihood diversification, make *Egodawatta* the most vulnerable village in terms of LAP (0.497) while *Weralabada* secured its place as the least vulnerable to LAP (0.338).

The eighth major sector is Socio-political Networks (SPN). It comprises seven subcomponents that describe political traits in addition to social aspects of the GNDs. This version differs from the original major components of the LVI version of Hahn et al. (2009) which considered only social aspects of the system. The significance of encompassing political traits in this conceptual model was elaborated in Chapter Two. However, to make LVI a simple tool, only two subcomponents that were most relevant to the study context were included. They were the percentage of households with members who, despite their qualifications, could not secure an occupation because of political influence, and the percentage of households that did not vote during the provincial council election in September 2013.

Approximately one third of well qualified households of each village complained about the political influence they encountered during the process of finding an occupation. *North Weralabada* recorded the highest percentage (38.5) of such respondents while the lowest was reported in *Egodawatta* (28%). More than 40% of the households of *Weralabada* (47.40%) and *Kurusapaduwa* (44%) stated that they did not vote during the last election while 28% of the households of both *South Weralabada* and *Egodawatta* stated the same. The attitudes of *North Weralabada* households towards elections and politics seemed to be more positive compared to the others as only 23.10% of them did not vote. While the majority of households in all villages expressed dissatisfaction with the political system, many of them did not use their voting power to change the very system with which they were disappointed. When they were asked for the reasons for not casting their votes, almost all of them stated that “it will not make much of a difference” as they believed that neither of the main political parties who eventually win the election would do things differently.

Every household of each GND reported that they received more in-kind assistance than they provided and borrowed more money than they lent, mainly from friends, relatives, and neighbours. The most common in-kind assistances were: sharing rice, vegetables, and associated cooking ingredients; sharing a bike or a bicycle for transportation; dropping or picking up a child from school; and care during indisposition, such as taking care of children while parents are out, or looking after petty shops while the owners could not do so. Borrowing money, on the other hand, was often associated with meeting daily needs, such as buying groceries, paying a school fee or a doctor's consultation fee, and paying back a loan. The index values of average receive to give ratio of the villages ranged between 0.135 and 0.325 where the lower limit was reported by *South Weralabada* and the upper limit was noted by *Kurusapaduwa*. Interestingly, the average borrow: lend ratio does not exhibit drastic variation where a maximum of 1 was recorded by *North Weralabada* and the lowest of 0.825 was recorded by *Weralabada*. A similar value of 0.827 for the same ratio was obtained by both *Egodawatta* and *Weralabada* whereas *Kurusapaduwa* noted a slightly increased value of 0.880. This reflects that the dependency for financial and in-kind assistance for their survival is common to all, despite the fact that they live in different geographical settings.

The households were also asked about their access to financial assistance beyond support from acquaintances in order to understand where they placed themselves in the broad social network, and also to assess financial inclusion that can be of assistance during times of need. For that, three subcomponents were employed: percentage of households that do not hold a membership in a CBO; percentage of households that had not gone to their local government for assistance during the previous 12 months; and percentage of households that had never taken a loan from the formal banking sector. Around 30% of households in both *Kurusapaduwa* (28%) and *Egodawatta* (32%) affirmed that they did not have a membership in any type of Community Based Organisation (CBO) while the lowest statistic of 20.5% was reported by *Weralabada*. The households of *North Weralabada* recorded the highest percentage of 38.46% for that criterion. Many people had a disinterested attitude towards such membership. The prevailing languid attitude of those households towards these societies was related to boredom rather than to dissatisfaction with or criticism of what these CBOs do. In fact, a few of the households appreciated the loan programmes operated by those organisations. However, once they

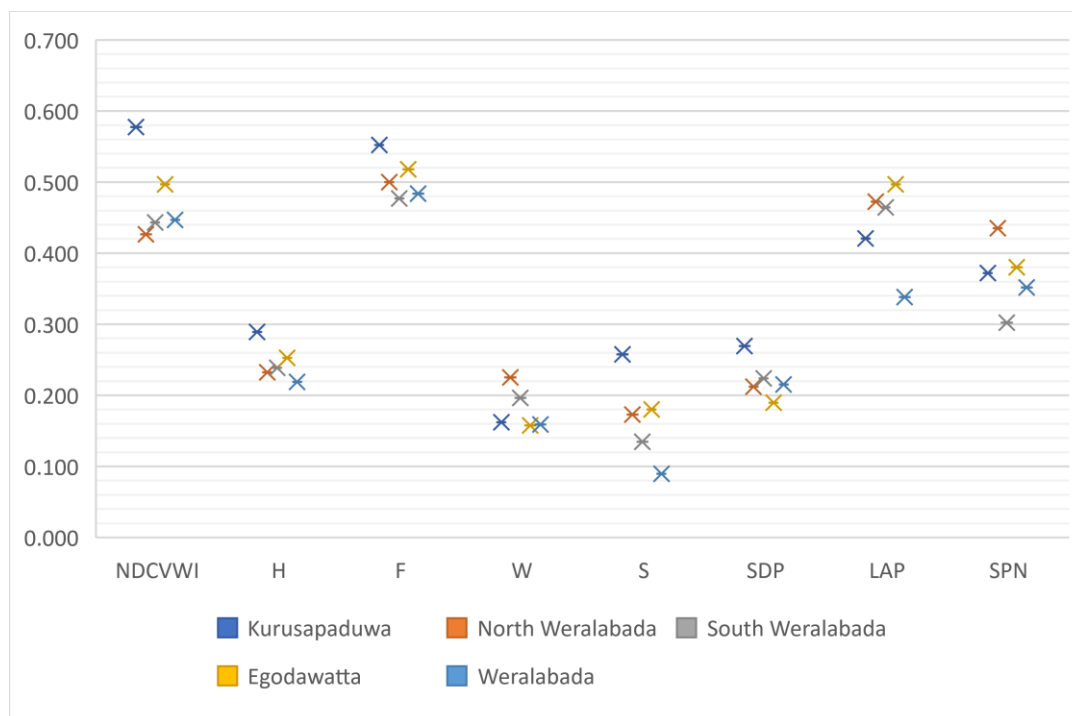
benefited from a scheme, they were no longer motivated to continue to be a part of it. A few highlighted the time demands of CBOs, with which they are unable to comply.

North Weralabada reaffirmed their negative attitude towards seeking help from social networks with a recorded considerable percentage of 61.5% who stated that they did not seek government assistance. Around half of the households of *Egodawatta* (48%) stated the same, while the lowest value of 21.20% was recorded by *South Weralabada*. When it came to networking with the formal banking sector, which is also reflective of the households' financial inclusion and financial literacy, the highest value recorded was 28% participants of *Egodawatta* who stated that they had never taken a loan from a formal banking centre. *South Weralabada* recorded the lowest value of 7.69%. When all seven subcomponents were averaged to understand the relative vulnerabilities of GNDs in terms of socio-political network, *North Weralabada* recorded the highest index value (0.435) compared to the others mainly owing to its residents' higher borrow: lend ratios despite their minimal involvement with CBOs and the formal financial sector. This may be a direct impact of their having the highest percentage of households (84.60%) who rely on money lenders for their usual livelihood activities. The majority of its households also complained about their inability to secure job opportunities due to the political influence of the powerful. A drastic variation between villages could not be observed in this regard with the lowest of 0.302 recorded by *South Weralabada*.

Figure 5.3 further clarifies what indicators of each village increase and decrease its overall livelihood vulnerability while providing insights into relative vulnerabilities across sectors and GNDs. Alternatively stated, it discloses which household traits contribute most to LV in each GND. The scale of vulnerability is set between 0 (the lowest vulnerability) and 0.6 (the highest vulnerability) as in Figure 5.2.

Figure 5.3

Major factor distribution across GNDs



Note. NDCVWI = Natural Disasters, Climate Variability, Warnings, and Impacts; H = Health; F = Food; W = Water; S = Shelter; SDP = Socio-demographic Profile; LAP = Livelihood Assets and Practices; SPN = Socio-political Networks Source: Author

Accordingly, all GNDs in general have higher relative vulnerability in four main sectors: Natural Disasters, Climate Variability, Warnings, and Impact (NDCVWI); Food (F); Livelihood Assets and Practices (LAP); and Socio-political Networks (SPN). In contrast, vulnerability of the sectors of Health (H), Water (W), Shelter (S), and Socio-demographic Profile (SDP) for all GNDs was comparatively low and located in and around 0.3, close to the lower end of the vulnerability range. Upon closer inspection, relating the results to an asset pentagon reveals a number of factors that contribute both to shrinking and expanding livelihood capitals. These are shown in Figure 5.4 and Figure 5.5. In other words, Figure 5.4 suggests the need for restoration of the asset pentagon to reduce livelihood vulnerabilities through capital investments of the required form (e.g., natural, physical, financial, human, and socio-political). This in turn can facilitate community development programmes.

Figure 5.4

Factors contributing to shrinking the asset pentagon and increasing the relative sector vulnerabilities of each GND

Kurusapaduwa

- Decline in fish stock
- Prone to natural disasters owing to their geography
- Low access to disaster awareness programmes
- Prevalence of chronic illnesses
- Poor dengue fever prevention mechanisms
- Low level of food availability and food utilisation
- Extreme dependency on external market for basic food
- Intense family burdens due to higher dependency ratio, high number of households with orphans and members needing assistance to perform their ADLs
- Less diversified fishery livelihoods
- Did not utilise the right to cast their vote even though they wish for change in governance

North Weralabada

- Poor sanitary facilities
- Extreme dependency on external market for basic food
- Lack of available drinking water
- Absence of deeds (land and house)
- Prevalent finance exploitation owing to higher dependency on money lenders for usual livelihood activities
- Victimisation by debt traps
- Less involvement in outside community and local government assistance programmes
- The ability to secure outside job opportunities is constrained by political influence

South Weralabada

- Decline in fish stock
- High number of household heads with no formal education

Egodawatta

- The second highest recorded natural disasters in place compared to other GNDs
- Inability to secure income earning activities due to illness
- The weakest garbage disposal service in place
- The lower level of food availability
- Fragile dwellings
- No access to electricity
- High number of households with the highest dependency ratio
- Poor acquisition of skills in different sectors (e.g., mechanics) other than fishery
- Households' reliance upon the livelihoods in and around their residences
- Non availability of assets of their own to conduct their livelihoods
- Poor financial inclusion with less transactions with formal finance sector

Weralabada

- Lack of available drinking water
- Intense family burdens owing to higher dependency ratio similar to Kurusapaduwa
- Low level of livelihood diversification
- Did not utilise the right to cast their vote even though they wish for change in governance

The factors identified in Figure 5.5 acknowledge the relative strengths of each GND. This is also beneficial in planning and implementing community development programmes by deciding to either improve or maintain them.

Figure 5.5

Factors contributing to expand the asset pentagon and reduce the relative sector vulnerabilities of each GND

Kurusapaduwa	North Weralabada	South Weralabada	Egodawatta	Weralabada
<ul style="list-style-type: none"> •children's immunisations are up to date •access to sanitary facilities •availability of drinking water •less dependency on money lenders for their usual livelihood activities •positive influence of the nearby urban area (e.g., job opportunities, access to improved health facilities) 	<ul style="list-style-type: none"> •children's immunisations are up to date •lower operational cost due to low level of fishing intensification at the time of low harvest •trust in warning signals, thus keen to follow them in the future •enhanced food utilisation practices •access to electricity •legal ownership of the dwellings •utilised their right to cast votes in the election •positive influence of the nearby urban area (e.g., job opportunities, access to improved health facilities) 	<ul style="list-style-type: none"> •children's immunisations are up to date •least number of natural disasters •enhanced food availability and food utilisation •availability of drinking water •access to electricity •less family burden due to lowest dependency ratio, a smaller number of households with orphans and members needing assistance to perform their ADLs •high level of financial inclusion •positive influence of the urban area (e.g., job opportunities, access to improved health facilities) 	<ul style="list-style-type: none"> •children's immunisations are up to date •availability of drinking water •all household heads acquired school education •high level of livelihood diversification •less political influence over job opportunities, thus were able to secure their places •positive influence of the nearby urban area (e.g., job opportunities, access to improved health facilities) 	<ul style="list-style-type: none"> •knowledge of disaster management protocols •low prevalence of chronic illnesses •dengue fever prevention measures are in place •access to sanitary facilities •enhanced food availability and food utilisation practices •satisfactory level of housing conditions •possession of the deed of their dwellings •hold the ownership of assets that they utilise for their livelihoods •low risk of debt traps •tendency to utilise opportunities outside the family and friends circle via membership with CBOs •positive influence of the nearby urban area (e.g., job opportunities, access to improved health facilities)

The following section sums up the ways in which the range of sector vulnerabilities impacts on overall relative LVI and LVI within the IPCC framework for each GND.

5.6 Overall Livelihood Vulnerability

Overall, *Kurusapaduwa* reported the highest LVI (0.371) whereas *Wearalabada* recorded the lowest (0.298). The relative vulnerabilities of GNDs are portrayed in Table 5.6 where four main colour codes are used to distinguish the degree of vulnerability in the respective variables and schemes of each GND that ultimately determines overall livelihood vulnerability of the GND. It clearly demonstrates that *Kurusapaduwa* recorded the highest vulnerabilities in five main sectors (natural disasters, climate variability warnings and impacts; health; food; shelter; and socio-demographic profile), the obvious reasons for it becoming the most vulnerable GND. *Weralabada* on the other hand reported the lowest vulnerability values on three main sectors (health, shelter, and livelihood assets and practices) and the second lowest value on another three sectors (food, water, and socio-political networks), thus recording the lowest LVI to weather related stresses and climate-related threats.

Table 5.6

Major sector vulnerabilities, overall LVI and LVI-IPCC of five coastal villages in Chilaw DS

Major Component	Kurusapaduwa	N- Weralabada	S- Weralabada	Egodawatta	Weralabada
Natural Disasters, Climate Variability, Warnings, and Impacts (NDCVWI)	0.577	0.427	0.443	0.497	0.447
Health (H)	0.289	0.232	0.239	0.253	0.219
Food (F)	0.552	0.500	0.477	0.518	0.484
Water (W)	0.162	0.225	0.197	0.158	0.159
Shelter (S)	0.258	0.173	0.135	0.180	0.090
Socio-demographic Profile (SDP)	0.270	0.212	0.224	0.190	0.215
Livelihood Assets and Practices (LAP)	0.421	0.472	0.464	0.497	0.338

Major Component	Kurusapaduwa	N– Weralabada	S– Weralabada	Egodawatta	Weralabada
Socio-political Networks (SPN)	0.372	0.435	0.302	0.380	0.352
LVI	0.371	0.339	0.317	0.341	0.298
Exposure	0.577	0.427	0.443	0.497	0.447
Sensitivity	0.314	0.281	0.264	0.278	0.242
Adaptive Capacity	0.554	0.547	0.590	0.569	0.610
LVI-IPCC	0.0074	-0.0339	-0.0387	-0.0201	-0.0395

Note. Red = highest V.; brown = second highest V.; dark green = lowest V.; light green = second lowest V. (except for adaptive capacity); for adaptive capacity: red = lowest V.; brown = second lowest V.; dark green = highest V.; light green = second highest V.; V = vulnerability of that particular main component. Source: Author

Egodawatta which recorded the highest vulnerability in livelihood assets and practices and second highest vulnerability in five other major sectors (natural disasters, climate variability, warnings and impacts, health, food, shelter, and socio-political networks) subsequently registered the second highest livelihood vulnerability (0.341). North Weralabada was the GND with the third highest LVI, with its highest vulnerability scores for water and socio-political networks and the second highest vulnerability in livelihood assets and practices, despite having the lowest vulnerability score on the main component of natural disasters climate variability, warnings and impacts. The second lowest LVI of 0.317 was recorded in *South Weralabada*, resulting from its lowest main components of food and socio-political networks.

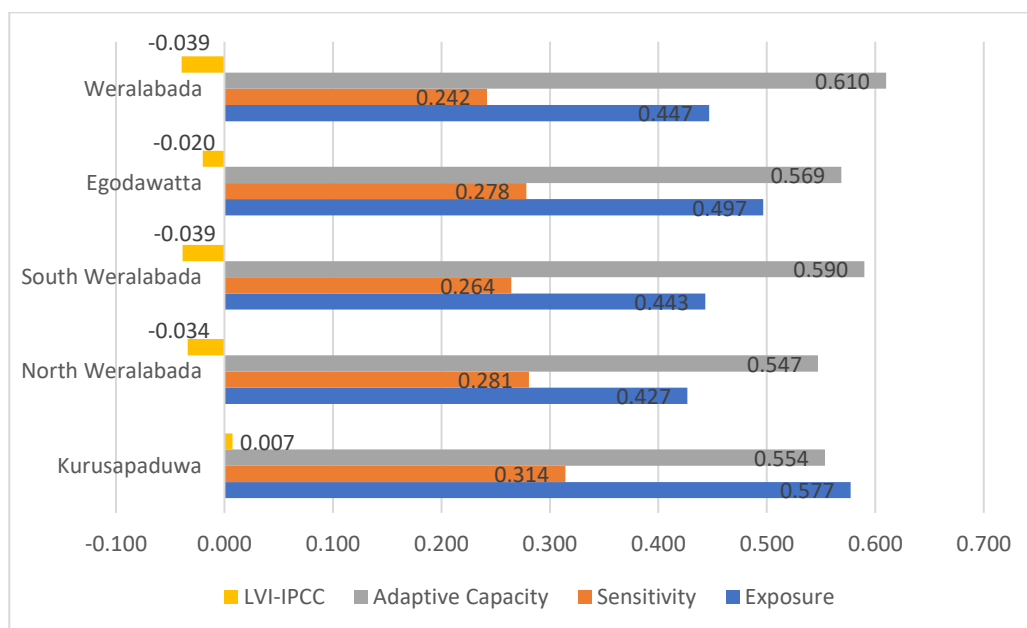
Another benefit of the LVI application is its accordance with the IPCC working definition of vulnerability which conceptualises it as a constituent of three main dimensions: exposure; sensitivity; and adaptive capacity, as do many other scholars. By utilising the identified values, this study organises the indicators of LVI around these three components as in Figure 5.6. Exposure in this study is characterised by the nature and degree of weather-related and climate-related stresses encompassing warning mechanisms in place. Sensitivity refers to the first-order effects of stresses or the capacity

of the systems to absorb disturbances at first place. Adaptive capacity is determined by the capabilities, resources, and institutions that are accountable for adaptive mechanisms. The LVI-IPCC is on a scale from -1 (least vulnerable) to +1 (most vulnerable).

The LVI-IPCC analysis yielded similar results where *Kurusapaduwa* turned out to be the most vulnerable to weather and climate-related distresses while *Weralabada* showed the least vulnerability.

Figure 5.6

Exposure, sensitivity, adaptive capacity, and LVI-IPCC of the five GNDs



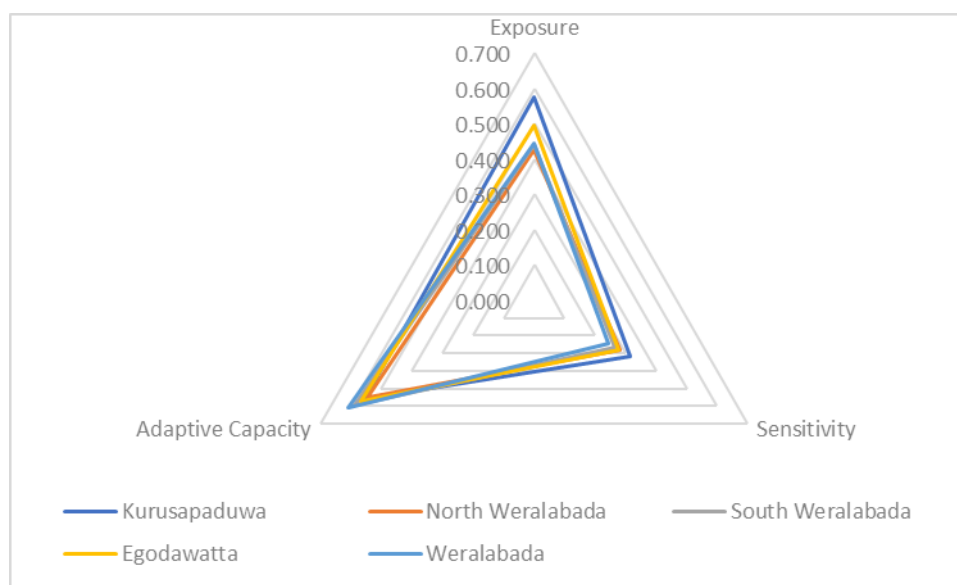
Note. Source: Author

Figure 5.6 further shows how the contributing factors of exposure, sensitivity, and livelihood vulnerability determine the LVI-IPCC value of each GND. It clearly demonstrates that *Kurusapaduwa* is highly vulnerable to the impacts of climate change due to its highest exposure and highest sensitivity compared to the other GNDs. In contrast to that, the lowest sensitivity and the highest adaptive capacity together made *Weralabada* the least vulnerable GND. However, the second highest value for adaptive capacity and the second lowest values for sensitivity and exposure earned *South Weralabada* a lower vulnerability rating, only slightly less than *Weralabada*, thus positioning itself in a better place in the LVI. The vulnerability triangle (Figure 5.7) illustrates how the contributing factors according to the IPCC definition of vulnerability differ in the five GNDs within the range of 0 (low contributing factor) to 0.7 (high contributing factor). *Kurusapaduwa* showed the highest exposure (0.577) with its highest NDCVWI value followed by

Egodawatta (0.497). Accounting for the prevalent conditions of health, food, water, and shelter suggested that *Kurusapaduwa* was more vulnerable also in terms of sensitivity than that of the rest of the GNDs. Adaptive capacity was found to be high in *Weralabada* (0.610) compared to other GNDs which recorded the values of 0.590 (*South Weralabada*), 0.569 (*Egodawatta*), 0.554 (*Kurusapaduwa*) and 0.547 (*North Weralabada*), from the highest to the lowest. *Weralabada* with its moderate exposure, lowest sensitivity, and highest adaptive capacity, was found to be the least threatened by impacts of climate change.

Figure 5.7

Vulnerability triangle diagram



Note. Source: Author

The application of formulae for the calculation of both LVI and LVI-IPCC was intended to be comprehensible for all who might make use of them. This simplicity facilitates the application of LVI and LVI-IPCC by a diverse set of users in an extensive range from policy makers to the personnel who implement and monitor villages at the ground level. Vulnerability spider diagrams and factor triangles can provide additional information when different systems are compared which can then be incorporated in community development programs. The application of LVI and LVI-IPCC has the potential to be a prodigious initiative, especially in a setting such as this where climate change is found to be as yet an abstract and novel concept. Therefore, the study also focuses on assessing individual cognitive aspects in terms of perception within the process of adaptation just as socioeconomic and political factors are prioritised in this study in determining livelihood

vulnerabilities of communities to the impacts of climate change. Accordingly, the next chapter discusses the extent to which the scale of perception affects LV of the villages and reflects on the role of peoples' perceptions in the process of adaptation.

Chapter 6. The Scale of Perception

6.1 Introduction

This chapter presents the scale of perception towards climate change impacts of respondents based on five perception indexes. It explains the constituents of the scale step by step and how the scale is constructed. In addition to the main dimensions considered in developing perception indexes, various other aspects are also examined to understand the context itself, the result of which is presented at the end of this chapter.

6.2 Construction of scales

Spector (2011b, p. 2) emphasises the significance of delineating the construct under investigation as a prior step to scale development, especially if the construct is “a theoretical abstraction with no known objective reality such as unobservable cognitive states like attitudes and values”. He further emphasises that the more complex and abstract the construct in its terms, the more necessary it is to define it beforehand. Beginning with its general definition and then moving on to specifics of the construct is one of the recommended approaches (Spector, 2011b).

Thus, examination of perception towards a complex phenomenon like climate change is required in order to identify its various facets before an index or a scale can be formed. The literature reveals a range of both complementary and conflicting theoretical perspectives on perception in relation to climate change impacts. According to Krause–Steger and Roski (2014), perception reflects emotional responses and different lifestyles in addition to knowledge and evaluation. However, assessment of knowledge on climate change has often been a major theme in risk perception research (Hasan & Nursey–Bray, 2018). Dretske (2006) also argues that awareness and understanding constitute perception while Li et al. (2017) suggest that awareness alone can nurture concern and stimulate adaptation actions. Similarly, Leiserowitz (2007) and Whitmarsh (2008) assert that perception primarily explores people’s understanding, awareness, attitudes, and policy preferences towards a particular hazard or a threat. Similarly, Grothmann and Patt (2005) argue that perceived risk is a combination of perceived probability and perceived severity which determine the process of adaptation in accordance with perceived adaptive capacity.

In consideration of those arguments, the whole construct is divided into five concrete subsegments or five main pillars that characterize the dimensions of perception with specific reference to climate change impacts:

- attitude and level of awareness about climate change and its impacts
- understanding of its causes
- community's familiarity with and experience of its impacts or exposure
- the sensitivity
- the capability to adapt to its consequences, that is adaptation efficacy and self-efficacy.

This subdivision is based on both theoretical and empirical utility which permit the development of multiple-item subscales to estimate different dimensions of the construct of perception (Spector, 2011b).

It is extremely difficult to create survey questionnaires that are easy for survey participants to understand, especially if such questionnaires intend to measure a cognitive status like perception of a complex phenomenon such as climate change. The respondents are members of communities that struggle to make a living out of natural resources who would probably have no idea about the complexity and certainty of global climate change. Thus, it may not be possible to measure the community's perception on climate change by means of a few questions alone. This raises the need for the subdivision of the construct in order to address the dilemma. Park et al. (2014) also recommend this approach.

Having this as the base, the dimension of impacts assists the estimation of perceived exposure. Estimation of the dimension of sensitivity is used as the estimated perceived sensitivity. Similarly, attitude and awareness, understanding of the causes, perceived adaptation efficacy and self-efficacy together demonstrate the perceived adaptive capacity. This amalgamation is premised in similar studies by Lata and Nunn (2012) and Hasan and Nursey-Bray (2018) who claim that awareness and understanding of causes are imperative to understand peoples' adaptive capacity. During the construction of scales, all five GNDs are considered as one group, thus the total number of participants is 206. This number accords with the position of Spector (2011a) who affirms that participation of 100–200 subjects would satisfy an initial development of a scale similar to this.

The statements of each index are designed in such a way as to reflect negative mean values with negativity and positive mean values, with positivity in relation to adaptation. Accordingly, positive mean values imply positive contribution either to improve adaptation or to reduce vulnerabilities whereas negative mean scores demonstrate negative effect on the said concepts. For example, if the answers to the statement that “climate change is mainly a result of human activities” generates a positive mean value, that means the majority agree with the statement or that they understand it as the main cause. Presumably, such an understanding could enhance the process of adaptation. However, there are two exceptions to this rule. The first exception is statement 5.1—“God will protect us”—which enquires perception of the role of God in the process of adaptation. It is not advisable to use a phrase like “God will not protect us” as an element to measure the status of adaptation, with a community who has a strong faith in God. Besides, Spector (2011c) argues, wording of a statement is mainly dependent upon the type of judgment or response participants are requested to make. Therefore, the item is phrased as “God will protect us” and calculated reversely as that belief is unlikely to contribute to an active participation in adaptation measures. That is the reason behind the estimated negative mean value of -0.825 of that particular statement, not because the majority disagree that they will be protected by God.

The second exception is applied to the segment of impacts and all its statements (statements from 3.1 to 3.15 of Table 6.4). Accordingly, the negative mean value of a statement suggests that the community does not perceive that particular attribute of climate as an impact of climate change. This indicates the majority does not perceive that particular impact of climate as a threat. The same is applied to a statement that generates a positive mean value where it suggests that the majority agrees with the statement.

As previously stated, each perception index is constructed predominantly on subjective dimensions. Nonetheless, it is a scientifically based tool that reflects the motives and values of the people (Krause-Steger & Roski, 2014). Transparency International (TI) who developed the Corruption Perception Index (CPI) claims that the perception index is important as it provides a space for mapping numerous dimensions (TI, 2012). In particular, this is beneficial when objective data are hard to obtain or not available. It also provides a lobby for unconscious dimensions that could support evident information during an analysis (Krause-Steger & Roski, 2014). Giving due consideration to these details,

the Likert Scale, the most popular tool of summated rating scales in cognitive assessments, is adapted in this study to estimate the perception of respondents on several aspects of climate change (Spector, 2011c). Young (2017) praised this technique for its ability to translate cognitive aspects into numerical forms which are readily interpretable and communicable to the public while Bertram (2007) and Croasmun and Ostrom (2011) highly regarded its simplicity and accuracy as a scientific tool.

6.2.1 Likert Scale

As defined by Bertram (2007), the Likert Scale “is a psychometric response scale employed in questionnaires to obtain respondent's preference or degree of agreement with a statement or series of statements” (p. 1). And it also measures how often they engage with certain events and behaviours (Spector, 2011d). This unidimensional technique (Croasmun & Ostrom, 2011) was pioneered in 1932 by Dr. Rensis Likert whose prime objective was to find a way to measure attitudes of the people in a scientific way (Likert, 1932). At present, the Likert Scale is widely applied in social science research due to its simplicity and reliability. More importantly, it is easy to read and complete from a respondents' perspective (Bertram, 2007; Maurer, 1998).

According to Spector (2011c), the most common types of choices used in the Likert Scale can be categorized into three: agreement; evaluation; and frequency. As implied by the terms themselves, in the agreement type the respondents are asked to choose the degree to which they agree with each item (e.g., "strongly agree" to "strongly disagree") whereas in evaluation they are asked to rate a good–bad dimension (e.g., "terrible" to "excellent"). The frequency choices of the scale require the subjects to mention how often something has happened or should happen (e.g., “rarely" to "most of the time"). In this construct two types of choices, agreement and evaluation, are employed because they accommodate the factors that I intended to measure. However, for the perception index, agreement response anchors are elected as this technique is quite versatile in nature (Spector, 2011c). The process of development of the Perception Indexes (PIs) involves two main steps: deciding upon the type and number of alternatives, and then composing the statements.

A five-point scale that consists of five choices appears to be the most widely applied (Bertram, 2007; Jamieson, 2004) although the optimum number of choices used in the

scale is being still debated (Croasmun & Ostrom, 2011). Cronbach, (1951) claims that a high degree of internal reliability of the scale can be achieved when the number of choices is increased from three to five. Symonds (1924) and Cohen et al. (2000) noted that the optimal reliability can be assured with a seven-point scale. However, five to nine response choices are considered to be optimal for most uses. The number of choices is conditioned by the measurement sensitivity of the respondents (Spector, 2011c). In consideration of all, a five–point scale appears to be most appropriate for this study to formulate perception indexes owing to its simplicity and ability to generate reliable results.

Irrespective of the type and number, the choices must follow an order (e.g., low to high or high to low) and each choice should be allocated a value to assist the analysis (Spector, 2011c). Attitude measurement studies similar to this very often adapt a bipolar rating scale owing to the fact that people often hold negative, positive, and neutral attitudes towards a phenomenon (Spector, 2011c). By giving respondents a choice of “neutral” point we expect to minimise the response bias (Randall & Fernandes, 1991) and avoid forcing the respondents to have an opinion even though they actually do not (Brown, 2000).

The second step, development of items, is essentially guided by the construct (Spector, 2011b) and the focus (Croasmun & Ostrom, 2011). Further, the phrasing of the item is largely governed by the alternative that participants are required to choose. For example, agreement type of scales usually employ declarative statements (Spector, 2011c). Accordingly, the study primarily follows the guidelines provided by Spector (2011c) to construct stems/statements of the study. They are: each statement expresses only one notion; jargon usage is avoided; and statements are developed in a manner that respondents can understand or carefully cater to their measurement sensitivity.

Despite its reputation as a scale, the Likert Scale has a few weaknesses: the tendency of participants to avoid extreme response categories (central tendency); likelihood of fabricating answers in attempt to please the interviewer (acquiescence bias); and the probability of respondents portraying themselves falsely and not being honest about their opinion (social desirability bias) (Bertram, 2007, p. 7). During the study, measures were applied to overcome the weaknesses of the scale such as ensuring effective communication and encouraging respondents to be honest. However, coastal communities are generally considered to be straightforward in expressing their opinions. I

also witnessed this during the interviews and believe that this enhanced the applicability of the Likert Scale in the study.

6.2.2 Content Validity

Haynes et al. (1995) define content validity as “the degree to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose” (p. 238). Content validity therefore has significant implication for research conclusions and thereby for their applications (Haynes et al., 1995). Rositter (2002) claims content validity to be the only validity required in development of scales, particularly in single item measurements given the condition that the construct is precisely defined. Moving further, he criticizes the application of typical statistical procedures (such as factor analysis and internal consistency reliability) to the selection of items, because of the damage it could cause to the original concept (Rositter, 2002). He strengthens this argument by providing the related cases of Narver and Slater (1990) and Taylor and Baker (1994) where the original concept is impaired as a result of such statistical applications used to “purify” items in scales. A number of alternative methods that will ensure content validity in studies can be found in the literature. Consultation of the group for whom the tool is intended is one of such methods among many that have been used. The method is suggested by Vogt et al. (2004) owing to its usefulness and practicality in application.

Messick (1995) also argues for expert consultation as an essential part of ensuring content validity of measurement tools. As demonstrated by Vogt et al. (2004) the term "expert" can be applied either to researchers who have expertise in the subject of concern or to members of the target group who have been experiencing the aspects of the constructs firsthand for a long time. In addition, members of the study group can be of great assistance in the item development stage because they can comment on the ease of understanding of the items, and on the representativeness of and relevance to the construct (Vogt et al., 2004). These two elements, relevance and representativeness, are the core aspects of content validity, thus measurement items are required to adhere to those key conditions.

According to Haynes et al. (1995, p. 239): "The relevance of an assessment instrument refers to the appropriateness of its elements for the targeted construct and function of

assessment" whereas representativeness "refers to the degree to which its elements are proportional to the facets of the targeted construct". Said otherwise, relevance refers to the extent to which the elements used in the measurement reflect the construct or the purpose of the study. Representativeness guarantees that the elements used in the measurement procedure neither overrepresent nor underrepresent the construct. It also ensures that required elements that define the construct are not excluded. Thus, the capability of the measurement tool to represent the construct under study is ensured. In brief, representativeness makes certain that the content domain is adequately covered by the items used in the assessment instrument. Relevance and representativeness are, however, strongly interconnected. As stated by Vogt et al. (2004), "an assessment instrument may contain relevant items but not tap proportionately all facets of a target construct, and thus, may not meet the criterion for representativeness" (p. 232). Hence, a data collection method that is applied to ensure content validity of the measurement items should be capable of addressing both key elements. The FGD, one of the data collection methods we employed during the study to harness regarded benefits, appears to be a promising tool in that regard (O'Brien, 1993; Vogt et al., 2004).

6.2.3 Formulation of Perception Index (PI)

Five main perception indexes are constructed to estimate the major dimensions of perception on climate change impacts. The method of calculation and allocation of point values to choices in this study is similar to that of the study of Wongnaa and Boachie, (2018), which attempts to understand the perception and adoption of Competency Based Training (CBT) by academics in Ghana.

The mean score \bar{X} of a perception statement on the Likert Scale is calculated as follows:

Equation 7

$$\hat{X} = \frac{\sum f_{ij}x_{ij}}{n}$$

where x is the ranked value of a perception statement i on the five-point Likert Scale and f is the total number of respondents assigning value x to a perception statement i on the five-point scale: Strongly Agree (SA), Agree (A), Neutral (N) or I Don't Know (IDK), Disagree (DA) and Strongly Disagree (SDA). The five-point Likert Scale takes a ranked value of 1 if respondent j strongly agreed to a perception statement i , 0.5 if agreed, 0 if respondent is

undecided (neutral), – 0.5 if disagreed, and –1 if strongly disagreed. The parameter n is equal to the total number of respondents.

The overall perception index (PI_d) for each dimension, which reflects the general agreement of all respondents on all perception statements on the Likert Scale pertaining to that particular dimension is computed:

Equation 8

$$PI_d = \frac{\sum f_{ij} \cdot x_{ij}}{n}$$

No of perception statements

All variables have their usual meaning where PI is the perception index of each dimension that is calculated separately using those formulae. A detailed example of calculation of perception indexes for “understanding–causes” is presented in Appendix E and the questionnaire used for the KAP survey is presented in Appendix F.

6.3 Calculation of PI: Measurement of Dimensions

The five main dimensions that exemplify climate-related perceptions are measured quantitatively which results in five respective perception indexes. Those indexes are used to demonstrate the perceived exposure, perceived sensitivity, and perceived adaptive capacity of the community as in Table 6.1.

Table 6.1

Perception indexes in relation to the three main factors of IPCC defined vulnerability

Representative Dimensions	Respective Perception Index (PI)
Perceived Exposure	Familiarity with and Experience of Impacts
Perceived Sensitivity	Sensitivity
Perceived Adaptive Capacity	Attitude and Awareness
	Understanding of Causes
	Adaptation Efficacy and Self Efficacy

Accordingly, each perception index attempts to reveal the extent to which the phenomenon of climate change and its impacts are embedded in coastal livelihoods and

reflected in people's perceptions. In particular, it is used to understand where they stand in the scale varied from strongly agree (+1) to strongly disagree (−1) on climate related aspects that are associated with their vulnerabilities and adaptations.

6.3.1 Attitude and Awareness

Despite the fact that the majority of respondents were unaware of the existence of a phenomenon called climate change, 38.3% agreed and 34% strongly agreed that attributes of weather including the natural environment in which they live, had changed, indicating their awareness of climate change (see Table 6.2). However, 16% of the sample was dubious about its existence while 11.7% disagreed. A similar percentage of 72.3% stated that they listen to weather-related news. The estimated collective values of the participants who “strongly agree” and “agree” with the statements that measure awareness on climate change's ability to threaten lives, livelihoods, and physical infrastructure were recorded as 61.6%, 63.6% and 42.7%, in order. With only 10.2% of the participants agreeing that they ever talked about the subject of climate change with an external official member, 30.1% were undecided and the majority of 59.7% disagreed. Remarkably, 61.2% agreed that the attributes of climate change on their lives, in particular their livelihoods, was a subject of the day-to-day conversation while 36.4% repudiated this statement. These conversations were, however, not the ones that include terminologies that are part of the glossary of global climate change. Instead, they revolved around an attribute of weather or change in the ocean that they notice and that has an impact on their livelihoods. The view of the majority was similar to that of household No.131 who strongly believed in the change in climate and who attributed that to decline in fish stock:

You asked me about the change. Nothing to say, it's so obvious. You know that the sea you can see over there, is our life. If something happens there, we are the first to know. In the last few years, the sea has changed in many ways. Unfortunately, not in our favour. No more fish to catch. That makes our lives very difficult.

(Household No 131 of *North Weralabada*)

Table 6.2*Perceived attitudes and awareness about climate change (CC) impacts*

No	Item	Choices/Alternatives					Mean Score
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)	
1	PI of Attitude and Awareness						0.043
1.1	I have heard the term “climate change”	0	6 (2.9)	0	200 (97.1)	0	-0.471
1.2	CC is real	70 (34)	79 (38.3)	33 (16)	24 (11.7)	0	0.473
1.3	We give attention to CC related news	69 (33.5)	80 (38.8)	18 (8.7)	37 (18)	2 (1)	0.430
1.4	CC is a threat to our lives	33 (16)	94 (45.6)	35 (17)	43 (20.9)	1 (0.5)	0.279
1.5	CC is a threat to our livelihoods	19 (9.2)	112 (54.4)	9 (4.4)	66 (32.0)	0	0.204
1.6	CC can damage physical infrastructure	0	88 (42.7)	53 (25.7)	65 (31.6)	0	0.056
1.7	Government/Pvt/NGO representatives talk to us about CC impacts	0	21 (10.2)	62 (30.1)	123 (59.7)	0	-0.248
1.8	We talk about CC (among ourselves)	1 (0.5)	126 (61.2)	3 (1.5)	75 (36.4)	1 (0.5)	0.124
1.9	We are aware about our country has an adaptation plan	0	0	16 (7.8)	189 (91.7)	1 (0.5)	-0.464

The calculated 61.2% that responded affirmative for statement 1.8 seemed to utilise these conversations as means of relieving themselves of concern over the effects such impacts had on their lives. This is quite a significant value compared to the percentage of respondents who agreed upon this type of communication channel as a source of information on climate change impacts discussed later in Section 6.8. Said otherwise, approximately only half of that (36%) selected communication among themselves as a source of information. (This statistic is found in Figure 6.7) as an answer to the question “from where you usually hear about climate change”. The reason for that difference is the weight that the two titles below put on different aspects. Here in “index development” it is emphasised more as an informal talk while in “source of information” it is inquired as

one channel of communication among many other popular sources of information. Alarming, 91.7% of the participants “disagreed” that they have ever heard about the presence of a climate change adaptation plan in Sri Lanka while 7.8% were undecided about the statement. This reflects poor communication between policy makers and community members on the subject of climate change.

Consequently, three of the nine statements of the respective dimension of perception ended up having negative mean values. These are: “I have heard the term climate change” (−0.471); “Government/Private /Non–Governmental Organisations’ representatives talk to us about climate change impacts” (0.248); and “we are aware that our country has an adaptation plan” (−0.464). These negative values reveal that the community in general does not agree with these statements, thus demonstrating their low level of access to information about these aspects. This in turn could negatively affect attempts to overcome climate change impacts. Similarly, positive mean values state that the majority in general agreed with particular statements. For example, the positive mean value of 0.204 for the statement that “climate change (CC) is a threat to our livelihoods” demonstrates the view of the majority of people who see it as a threat. In all, a positive Perception Index (PI) of 0.043 for the whole construct indicates that the overall level of attitude and awareness of the community on climate change impacts is satisfactory, or in other words they don’t deny the existence of climate change. This could have a positive influence on the overall process of adaptation.

6.3.2 Understanding– Causes

The results (Table 6.3) also showed that 32.5% collectively (32.0% disagreeing and 0.5% strongly disagreeing) disagreed with the statement that “climate change is mainly a result of human activities” while 4.4% strongly agreed, 43.2% agreed and 19.9% were undecided. When underlying causes were queried during qualitative interviews, it was revealed that the respondents’ perception of human contribution to global climate change was not essentially built upon scientific explanation of its causes. The perception about its origin is instead related to their local knowledge, experience, and faith akin to what Finucane (2009) also claimed in his account of Pacific Island communities and their vulnerabilities to climate change impacts.

Table 6.3*Perceived level of understanding on causes of climate change (CC) impacts*

No	Item	Choices/Alternatives					Mean Score
		SA (1)	A (0.5)	N/IDK (0)	DA (- 0.5)	SDA (-1)	
2	PI of Understanding–Causes						-0.158
2.1	CC is mainly a result of human activities	9 (4.4)	89 (43.2)	41 (19.9)	66 (32.0)	1 (0.5)	0.095
2.2	Fossil fuel burning and deforestation contribute to CC	0	1 (0.5)	175 (85)	29 (14.1)	1 (0.5)	-0.073
2.3	I have heard about GHGs	0	1 (0.5)	0	204 (99.0)	1 (0.5)	-0.498

People predominantly attributed these variabilities to natural processes, divine powers, destructive fishing methods, pollution (mainly solid waste) and consumerism. Some perceived climate change as a result of a combination of all these factors. The perceived causes however tended to revolve mainly around the issue of decline in fish stock, being due to the critical impact it already had on their livelihoods. The group that did not perceive any change obviously denied all the causes presented for their consideration. Similar to these findings, farmers in Mozambique suggested that climate change is a result of four main causes: gods and ancestors expressing their dissatisfaction for what farmers do these days; a result of a natural process; their own farming activities; and pollution outside their community (Patt & Schroter, 2008).

These results are also consonant with the argument of Maslin and Austin (2012) who claim that, in general, people are unable to relate the challenging issues that they encounter to the causative physical processes of climate change due to their limited knowledge of the processes. In a similar argument, Hasan and NurseyBray (2018) affirm that the awareness of the causes and physical processes of climate change of coastal communities is either very poor or inconsistent with scientific explanations.

This limited knowledge of the causes of climate change was further proven when out of 206 respondents only one agreed to the statement that fossil fuel burning, and deforestation contribute to changes in climate while 85% had doubts about whether to agree or disagree. The number of people who were undecided were aware that one or both of those acts can harm humans or nature but had no idea how. So, when they were asked whether they can relate that perception to climate change issues, they were confused and chose to stay neutral. Similarly, 14.1% (29) disagreed with the same statement while only 1 person strongly disagreed. When the participants were asked whether they have ever heard about GHGs only one person agreed, and one person strongly disagreed while the rest (204) disagreed. This further indicates their limited scientific knowledge of the causative physical processes of climate crisis, even of the very basics that are generally assumed to be known by a lay person or the public at large.

Subsequently, the negative PI of -0.158 indicates that the knowledge about causes of climate change of the community is not satisfactory because the people in general did not recognise the real causes of climate change phenomena. The results indicate that the community is mostly unaware of or uninformed about the causes and the associated physical processes of global climate change. It reveals that scientific knowledge of climate change was not passed onto these communities, thus there is a need for proper information channels to fill the gap. Hence, these findings have significance for policy makers. However, passing scientific information on to community members or the wider public may require integration of local dialect into those academic and technical terms. Association of those local terminologies with impacts with which people are familiar, could be one simple way to perform that. This practice was applied during the surveys.

6.3.3 Familiarity and Experience with Impacts: Perceived Exposure

38.8% of the respondents strongly agreeing that fish stocks are declining, and a further 42.7% agreed (Table 6.4). Yet, there were 14.6 % who disagreed with the statement while 3.9% were undecided. 45.1% disagreed that fishing seasons are affected by anomalies while 42.2% agreed. The percentage of respondents who were dubious about such anomalies was measured as 12.6%. In general, this demonstrates the probable presence of anomalies in the fishing seasons. In particular, household No 186 of *South Weralabada* commented on starting and ending dates and duration of fishing seasons:

In the past we usually had an exact date as to when 'Waarakan' (one of two main fishing seasons) starts. So, after six months of 'Walaala' (the other fishing season) then comes the "Waarakan". Usually, May 2nd week, or 13th of May depending on how the stars appears (*Hathdinnath Tharu*) 'Waarakan' begins. Now it is different, sometimes until the end of May 'Walaala' exist. When we were young, 10–12 years ago you can't even think of fishing during the season of 'Waarakan'. The sea used to be very rough. But now it is not that rough. But not many fish to catch. (Household No 186 of South Weralabada)

Table 6.4

Perceived level of exposure to the impacts of climate

No	Item	Choices/Alternatives					Mean Score
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)	
3	PI of Familiarity and Experience–Impacts						-0.068
3.1	Fish stocks are declining	80 (38.8)	88 (42.7)	8 (3.9)	30 (14.6)	0	0.311
3.2	Fishing seasons are having anomalies	0	87 (42.2)	26 (12.6)	93 (45.1)	0	-0.015
3.3	Sea level is rising	0	9 (4.4)	36 (17.5)	147 (71.4)	14 (6.8)	-0.403
3.4	Beach erosion is increasing	0	15 (7.3)	31 (15)	127 (61.7)	33 (16.0)	-0.432
3.5	Atmospheric temperature is increasing	35 (17)	86 (41.7)	49 (23.8)	35 (17.0)	1 (0.5)	0.289
3.6	Rainfall anomalies are increasing	0	41 (19.9)	83 (40.3)	81 (39.3)	1 (0.5)	-0.102
3.7	Wind speed is increasing	0	73 (35.4)	54 (26.2)	78 (37.9)	1 (0.5)	-0.017
3.8	Wind direction is showing abnormalities	0	66 (32.0)	88 (42.7)	51 (24.8)	1 (0.5)	0.032
3.9	Lightning is becoming frequent	0	37 (18.0)	37 (18.0)	123 (59.7)	9 (4.4)	-0.252
3.10	Lightning is becoming scary	0	97 (47.1)	44 (21.4)	64 (31.1)	1 (0.5)	0.075
3.11	Floods are becoming frequent	2 (1)	48 (23.3)	48 (23.3)	105 (51.0)	3 (1.5)	-0.143
3.12	Floods are becoming intense	0	35 (17.0)	53 (25.7)	117 (56.8)	1 (0.5)	-0.204
3.13	Cyclones are becoming common	0	69 (33.5)	50 (24.7)	86 (41.7)	1 (0.5)	-0.046
3.14	Tornados are becoming common	6 (3)	76 (36.9)	33 (16)	90 (43.7)	1 (0.5)	-0.010
3.15	Risk of occurrence of tsunami	0	41 (19.9)	89 (43.2)	71 (34.5)	5 (2.4)	-0.097

Significant percentages of 71.4% and 61.7% of respondents disagreed with the statements about the sea level rising and beach erosion increasing, respectively. The rock extending along the shallow sea that margins the beach was nominated by many as cause of these events. The majority of the participants (17.0% strongly agreed and 41.7%

agreed) perceived that the temperature is increasing, making their lives uncomfortable. In their own words: “during daytime we feel like we are burning”.

In contrast, only 19.9% agreed that anomalies in rainfall were increasing while 40.3% were doubtful as to whether facets of rainfall have changed. A further 39.3% disagreed with this statement. The increase in wind speed and abnormality in its direction were perceived as a stress by 35.4% and 32%, respectively. However, 37.9% did not perceive any changes in wind speed so they disagreed with the statement while 26.2% stated that they couldn't comment. A significant number of respondents (42.7%) were doubtful about the changes in wind direction whereas 24.8% disagreed. The results also show that the majority of 47.1% agreed with the statement that lightning is becoming scary, although 59.7% disagreed that it is frequent. However, most participants did not perceive floods and cyclones as threats. Only around 20% perceived the former as a threat while around 30% viewed cyclones as a risk. The perceived risk of a tsunami was also low—only 19.9% agreed with the statement while 34.5% disagreed. However, the majority of respondents (43.2%) were dubious about a tsunami occurring again, discerning it as a decision of God on which they could not comment. The people who disagreed also associate their decisions with faith in God, stating that God protected their community during the most devastating 2004 tsunami, so will do in the future. This clearly exemplifies the complexity of thinking that is not based on science as people attempt to navigate the circumstances that either happened in the past or will happen in the future to a level with which they are comfortable. Their responses are not likely to be purely “logical”.

Almost all these percentages consonant with the results of descriptive analysis (Section 6.8), where around similar numbers declare the same type of threats prevail in the area, thus supporting data validation. The exception is decline in fish stocks. This difference is attributable to two main reasons. First, some of the fishery and fishery-related residents who saw it as a major concern were reluctant to associate that with the phenomenon of climate change. Secondly, some of the residents from the non-fishery group did not acknowledge the decline of harvest as one of their major concerns. It is also important to note that unlike other impacts, tsunami are not familiar to them or not yet in the list of natural disasters that they often think of or are afraid of. The main reason for that is the trivial damage 2004 tsunami caused to them compared to the devastation it caused in the Southern and Northern parts of Sri Lanka.

The negative value of PI (−0.068) for this particular construct suggests that the majority of respondents disagree with the statements provided to measure the extent of climate change impacts on their livelihoods. Said otherwise, many of the stated impacts are not yet perceived by them as climate-related threats. This value also reflects their overall perceived exposure which appeared to be low.

Yet there are a few statements that scored positive mean values which means the majority accepted the existence of those particular impacts. Accordingly, the community in general perceived declining fish stock (0.311), increasing atmospheric temperatures (0.289), abnormalities in wind direction (0.032) and intense lightning (0.075) as the major impacts of climate change that they experience.

6.3.4 Perceived Sensitivity

In its simplest form, sensitivity often refers to the ability of a system or household to absorb the risk while adaptive capacity demonstrates an ability to recover from the risk (Adger, 2006). Thus, they often share similar elements in their assessments as they both measure the type of an ability or inability to deal with the risk. For example, the livelihood capital element of SLA which estimates the ability of households to withstand and recover from the perturbations they encounter, could fit into either of these themes depending on what the study intends to measure. In fact, the capital approach to understanding livelihood vulnerability and sustainability is claimed a success by many scholars, because it largely determines the sensitivity and adaptive capacity of households (Badjeck et al., 2010; Carney, 1999; Chambers & Conway, 1992; DFID, 1999; Knutsson, 2006; Turton, 2000). Accordingly, this study employs four main elements: food, water, shelter, and health to measure both objective and subjective sensitivity, respectively as in the livelihood vulnerability index and perception index.

As shown in Table 6.5, three quarters of the respondents disagreed (55.8% disagreed and 19.9% strongly disagreed) that they have secure access to food. On the issue of water, around half of them (42.7% disagreed and 9.7% strongly disagreed), stating that they did not have secure access to water. Likewise, 41.3% disagreed and 3.4% strongly disagreed that their dwellings are secure while 30.6% mentioned the opposite. However, as an outside observer, I could see the improvement in housing conditions in the area where only 5 participants lived in coconut thatched houses while the rest had brick (walls) and

tile (roof) houses. The condition of the area is very different at present even compared to the 25-year-old picture memory I have in my head, as at that time the beach and surroundings were full of fragile coconut thatched houses which no longer exist. In terms of health more than half of the participants do not believe that they have safe access to health facilities. Consequently, all four statements generate negative mean values which implies the respondents in general believe that they are not in a position to absorb the impacts of climate change. Said otherwise, they believe that they are sensitive to impacts caused by climate change. Subsequently, the negative perception index of sensitivity of – 0.156 demonstrates the same.

Table 6.5

Perceived level of sensitivity

No	Item	Choices/Alternatives					Mean Score
		SA (1)	A (0.5)	N/IDK (0)	DA (- 0.5)	SDA (- 1)	
4	PI of Sensitivity						-0.156
4.1	I have secure access to food	0	34 (16.5)	16 (7.8)	115 (55.8)	41 (19.9)	-0.396
4.2	I have secure access to water	0	95 (46.1)	3 (1.4)	88 (42.7)	20 (9.7)	-0.080
4.3	I have secure access to shelter	0	63 (30.6)	51 (24.7)	85 (41.3)	7 (3.4)	-0.087
4.4	I have secure access to health facility	0	89 (43.2)	6 (2.9)	108 (52.4)	3 (1.4)	-0.061

6.3.5 Perceived Adaptation Efficacy and Self-efficacy

As statement 5.1 in Table 6.6 exhibits, in contrast to the belief that “God will protect us” (71.4% strongly agreed while 25.2% agreed), 64.1% agreed with the statement that “we need to adapt” whereas 13.6% stated that they believe the measures they have taken reveal adaptation to climate stresses. This acknowledgement and the positive modifications that they made in their livelihoods (which is reflected in the statement of “we made positive differences in our livelihoods to overcome climate change impacts” are of vital importance to policy makers. This remarkable percentage will determine the effectiveness of adaptation measures. In referring these findings to Stages of Change Model (SCM), the 64.1% who agreed with the statement “we need to adapt” represent

the group who were at the stage of contemplation and who may or may not have moved into the action stage. It is also fair to assume the 13.6% of the respondents were either in the preparation stage or action stage as they believed that they had already taken measures to adapt.

Table 6.6

Perceived Self-efficacy and Adaptation Efficacy

No	Item	Choices/Alternatives					Mean Score
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)	
5	PI of Perceived Adaptation efficacy and Perceived Self efficacy						-0.329
5.1	God will protect us	147 (71.4)	52 (25.2)	4 (1.9)	3 (1.5)	0	-0.825
5.2	We need to adapt	0	132 (64.1)	41 (19.9)	32 (15.5)	1 (0.5)	0.238
5.3	We think we made positive differences in our livelihoods that may assist the stresses of climate threats	0	28 (13.6)	10 (4.9)	98 (47.6)	70 (34.0)	-0.510
5.4	I have enough knowledge and skills to adapt	25 (12.1)	106 (51.5)	9 (4.4)	60 (29.1)	6 (2.9)	0.204
5.5	I have reliable access to family/friends/ cooperatives for assistance	0	26 (12.6)	38 (18.4)	109 (52.9)	33 (16)	-0.362
5.6	I have a reliable income	0	49 (23.8)	13 (6.3)	111 (53.9)	33 (16.0)	-0.311
5.7	I have reliable access to other income sources/savings/credit	1 (0.5)	36 (17.5)	6 (2.9)	123 (59.7)	40 (19.4)	-0.400
5.8	I have enough movable/immovable assets to survive during a hardship	0	46 (22.3)	4 (1.9)	98 (47.6)	58 (28.2)	-0.408
5.9	We have better roads/markets/transportation	0	47 (22.8)	5 (2.4)	121 (58.7)	33 (16.0)	-0.340
5.10	We have enough resources to evacuate during a disaster	0	30 (14.6)	70 (34.0)	74 (35.9)	32 (15.5)	-0.262
5.11	My rights are protected by public institutions (enforcement of law)	0	0	10 (4.9)	195 (94.7)	1 (0.5)	-0.478
5.12	I am acknowledged and included in the decision-making process by formal institutions	0	1 (0.5)	1 (0.5)	203 (98.5)	1 (0.5)	-0.495

The perceived adaptive capacity is broadly characterised based on livelihood assets of SLA (Below et al., 2015; Wheeler et al., 2013). The aspects were highlighted by altering social capital into socio-political capital in the pentagon of livelihood assets of SLA based on the arguments of McLeod (2001) and Kahan et al. (2012). It is vitally important to address political facets of a community that claimed they were socially discriminated against, and that expressed concerns about their experiences of poor government. Accordingly, statement 5.4 (I have enough skills and knowledge to adapt) on Table 6.6 determined the human capital while socio-political capital was measured with the assistance of statements of 5.5 (I have reliable access to family, friends, and cooperatives for assistance), 5.11 (my rights are protected by public institutions—enforcement of law), and 5.12 (I am acknowledged and included in the decision-making process by formal institutions). Similarly, financial strength was assessed according to 5.6 (I have a reliable income), 5.7 (I have reliable access to other sources), and 5.8 (I have enough movable/immovable assets to survive during a hardship). Physical strength was estimated with the assistance of the statements of 5.9 (we have better roads/markets/transportation) and 5.10 (we have enough resources to evacuate during a disaster).

The results indicate that 53.9% and 16.0% disagreed and strongly disagreed, respectively that they have a reliable income. On the contrary, 63.6% acknowledged (12.1% strongly agreed and 51.5% agreed) that they have enough knowledge and skills to adapt. Thus, a remarkable human strength was claimed which is mainly associated with fishery itself.

Further, 52.9% disagreed that they can rely on their social network including family and friends in time of need because they all face similar difficulties in life. A number of participants further argued that their relatives and friends in the area mostly relied upon fishing as the main income, so the impacts affect everyone at the same time, leaving them helpless. This revealed that external help for coastal communities in time of need is essential. Likewise, 47.6% disagreed and 28.2% strongly disagreed that they have enough movable or immovable assets to survive during a hardship, whereas three quarters of the respondents stated that the area lacks adequate infrastructure mainly assessed through roads, markets, and transportation facilities. Around half of the participants (51.4%) stated

they disagree with the statement that “we have enough resources to evacuate during a disaster”. Poor physical strength is obvious. This situation was the same for political strength, although the results for the latter are starker. More than 90% stated their rights were neither protected by the public institutions (95.2%) nor were they themselves acknowledged and included in decision making processes (99.0%). A similar percentage of participants stated these as two of their major concerns. This is further explained under descriptive analysis (Section 6.8), thus supporting cross-validation of the data.

Only two statements returned positive mean values out of the fourteen statements queried under adaptation, namely “we need to adapt” and “I have enough knowledge and skills to adapt”. This reveals community members in general agree that they have to adapt and also believe that they have enough knowledge and skills to do so. Yet, the majority of fishers again speak about their skills in relation to fishery, not about an income portfolio of diverse income sources. Furthermore, the PI of -0.315 which resulted for the whole construct reveals that the community believe that they are not capable of overcoming the impacts of climate change. Overall, the five main dimensions used in the study to understand the perception of the community generated five different perception indexes that propose the degree to which the respondents perceive climate change and associated vulnerabilities and the extent to which they are prepared to face the phenomenon. Figure 6.1 demonstrates as to where the PI of each dimension stand along the continuum of Strongly Agree (+1) and Strongly Disagree (-1).

Figure 6.1

Positioning PIs along the continuum of Strongly Agree (+1) and Strongly Disagree (-1)

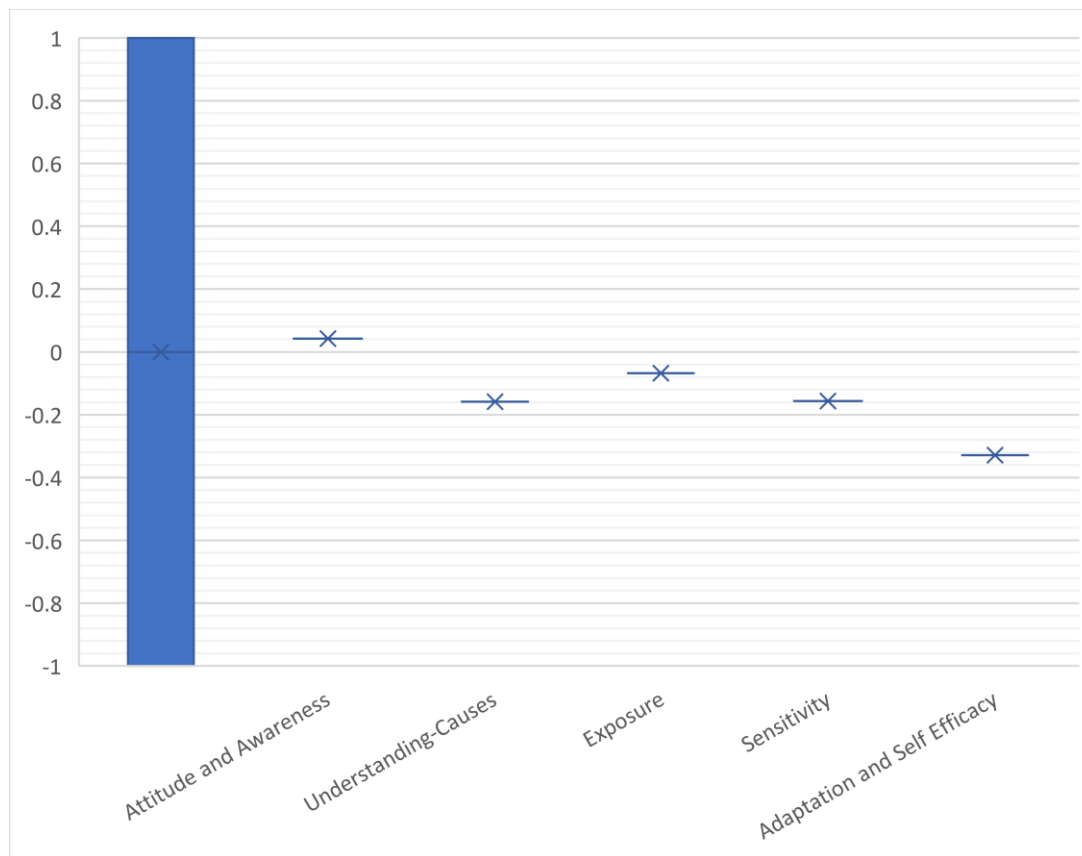


Figure 6.1 indicates somewhat satisfactory level of awareness of this community on the subject of climate change and its ability to threaten their lives and livelihoods with the value that lies just above the zero (0) for the PI of attitude and awareness. However, the figure also demonstrates the poor knowledge this community possesses about the underlying causes of climate change. This will hinder their ability to absorb and adapt to its impacts, as reflected by the recorded minus PI values for perceived sensitivity and perceived adaptation and self-efficacy. In all, this form of analysis can be beneficial in developing solutions to climate change adaptation as it clearly demonstrates the areas to which policy makers need to be attentive and the priorities necessary for involving the communities in the process of adaptation. People make decisions to act based on what they perceive and understand.

6.4 Contextual Revelation: The Role of Perception

There are two reasons for integrating the phenomenon of perception into the assessment of livelihood vulnerability. First it elucidates how coastal people view,

understand, define, and respond to climate-related impacts with specific reference to their livelihoods. Secondly, both subjective judgements and objective estimations facilitate a holistic view of the existing vulnerabilities and hindrances to adaptation.

Despite its prevalence as a subject among scientists and researchers, the phenomenon of climate change proved too abstract for the studied coastal community where 97.1% (200) of the respondents disagreed that they had heard the term climate change, even though some had apparently adapted to certain effects. For example, household No 58 of *Weralabada* left fishery for an ornamental fish business, owing to the unpredictable harvest of fish and damage caused to his boats by floods. However, the household head has never heard the term climate change. As he put it:

We are born with fishery. But not like 10–20 years ago, it's becoming more and more difficult. We have satellite technology to locate fish. But what is the use of that if there is no fish in the sea. All the fish might have gone somewhere or hide somewhere else because the condition here in this sea is not favourable for them. Also, now it is very hard to predict the behaviour of wind ("*yetththuwa*") and sea current ("*diyakada*"). All these are important things for a good fish catch. And when there is flood, it's hard to fish. My boat got damaged by floods a number of times. So, the last few years I was not making much profit out of it and even that was very unsure. So, I was disappointed and tired and wanted to do something that I have the control of. You see, we can't control everything. People think they can. But actually, it is not possible. So, I started this "ornamental fish business. (Household No 58 of *Weralabada*)

However, this unfamiliarity with the term climate change in one way appeared to be linguistic. The term is absent in the day-to-day speech of these communities, although its impacts are realised by them. The Sinhala translation of climate change which is "*Deshagunika Wiparyaasha*" is often used in formal and written language but seems too abstract for the participants. This is similar to the constraints experienced by Rahman (2014) in a related study conducted in Bangladesh. Additionally, it was interesting to note

that a considerable number of residents in the area speak the Tamil⁷ language despite them belonging to the Sinhalese, the majority of Sri Lanka.

Even if the respondents were familiar with the term “weather” (*Kaalagunaya*) they couldn’t distinguish it with the term “climate” (Reynolds et al., 2010). This was identified as a common situation in both developing (Kuruppu & Liverman, 2011) and developed (Lorenzoni et al., 2007) countries. For example, unpredictable weather that they had been experiencing for years for them was an abnormality in nature about which they wonder, not global climate change. Likewise, the respondents, in particular fishers, perceived change in wind direction either as a variability of weather or anomaly in fishing seasons, but not a climate matter. Hasan and Nursey–Bray (2018) also found that the perception of communities is constructed in their local context with its specific cultures, experience, faith, and values, which may not link directly with scientific explanations. These findings in fact complement the theory of Ingold who argues that perception of communities is fundamentally guided by the local context within which they experience life. Thus, they understand local variability of weather, but not global climate change (Ingold, 2007).

Ingold (2007) primarily speaks of weather and its ability to shape the actions of the people and determine their ways of being. In his theory he refers to this as “the weather world” where climate is viewed as a phenomenon that depends upon documentation and statistics while weather is demarcated as the gateway to its experience (p. S32). Thus, the implications of his view are that the general public who do not record or document changes to climate-related variables over a long period of time can only understand and speak about weather which they experience all throughout their lives. Consequently, when climate scientists and the general public talk about the phenomenon of climate change, the former actually speak about global climate while the latter speaks about local weather (Ingold, 2007).

In other words, global climate change which is expressed in statistical data and models is a distant phenomenon for local communities whose understanding is built upon the context they live, thus for them what matters is changes of weather (Ingold, 2007; Baron & Petersen, 2015). Moving further, Ingold (2007) argues that a layperson imagines the

⁷ Even though both Sinhalese and Tamil are official languages of Sri Lanka, the former is the language of majority while Tamil is spoken by a group of minorities.

future with reference to their past and present experience, thus past, present, and future experiences are all connected. This is different from the “climate scenarios” in which governments and planners are interested (Ingold, 2012)—a fictive future that they predict will prevail within 20 to 100 years. Leyshon and Geoghegan (2012) criticize the attempts of policy makers who prefer to focus on models, as ways to react to a problem that neither exists in the present nor is it certain how it will emerge in the future. Therefore, following Ingold’s line of thought, it is vital for governments and planners to understand people’s perceptions of climate change now and in the future as a product of everyday experience that has its roots in the past and affiliation with the present rather than as a separate product that simply appeared after a certain period of time (Baron & Petersen, 2015).

Also, due to the complexity of the subject of perception, it is imperative to note that filling the questionnaire on perceptions about climate change impacts was not straightforward. In formulating all statements, I decided to avoid the use of term “climate change” during the survey and qualitative interviews. Instead, the participants were encouraged to talk about attributes of climate change or elements of weather such as temperature, rainfall, wind, and changes in the sea and the impact of these on livelihoods within the context they live and in relation to present and past experience of them. This proved to be an effective way of discovering people’s perceptions about climate change when have been living with its consequences for more than a decade without awareness of the associated technical language and theory.

In this study I considered the changes to weather that the participants observed and experienced throughout their lives as proxies for climate change. Otherwise, it is challenging to relate climate change impacts to people’s livelihoods and associated vulnerabilities and subsequently to respective adaptation measures, the ultimate goal. Accordingly, despite their lack of understanding of the term climate change, whoever acknowledged that the attributes of climate or as they see it of local weather, have changed, was considered as a participant who admitted that climate change is real. For example, a fisher from *South Weralabada* spoke about how the sea has changed over the years even though he never heard the term climate change.

So, you asked me what sort of differences I noticed in the sea and the environment I live in. Oh, it’s very different. I mean it’s huge. We don’t have fish here anymore. Ocean current (*diyakada*) is different, so is wind (*yeththuwa*). They all are not

supporting us. And these sudden changes happen in the sea confused us. We think there is no way we have a cyclone today and set off for fishing. Suddenly here comes a cyclone. We feel like we don't know the sea anymore. Even in land, we experienced two tornados so far which we never saw earlier. Strange things are happening. Only God knows why. (Household No 170 of *South Weralabada*)

However, there were participants who wondered about the causes and were inclined to ascribe them to God or divine powers. Belief in divine powers seemed to be one of their prime sources of strength, thus their view of life, encompassing risk perception, is largely influenced by this faith. Many of the participants mentioned that it is impossible for them to go on fishing and struggle with the sea without God's support. This seems to be a widespread belief. Schmuck (2000) states that people in Bangladesh consider floods, tornados, and cyclones as acts of God. They also believe that God has protected their lives from whatever threats they have faced so far and will continue to do so in the future (Hasan & Nursey-Bray, 2018). Similar belief was noted among the respondents in all five GNDs.

With that strong belief, the common phrases found in the conversations of the participants were: "it's God's will"; "God will guide us"; "God only knows why"; "God is the only reason we are alive today"; "if that is God's will, we accept it"; "we are sure that God has a good reason for that"; "all our lives are in God's hands"; "God must be angry for what people do"; and "all our ancestors lived along the sea belt and so are we today. Without God's support it's impossible otherwise". The large number of statues of Jesus Christ, Saint Sebastian, and Saint Mary placed along the sides of the roads, close to residents' houses despite their proximity to several churches bears witness to faith. So do the festive church ceremonies. These ceremonies hold a significant place in their social and cultural lives. Essentially, such ceremonies appeared to be the most important events in many of the respondents' lives. This strong faith is further illustrated by household No 149 as an answer to the question of whether she believes there will be another natural disaster like tsunami:

No, we will not get a tsunami. Our Parish Priest told us. Even the last time we were protected by God. (She was referring to the 2004 tsunami). God will not allow something like that to happen to this area. After the 2004 tsunami all villagers took part in the event which was conducted in the beach organised by our Parish Priest to

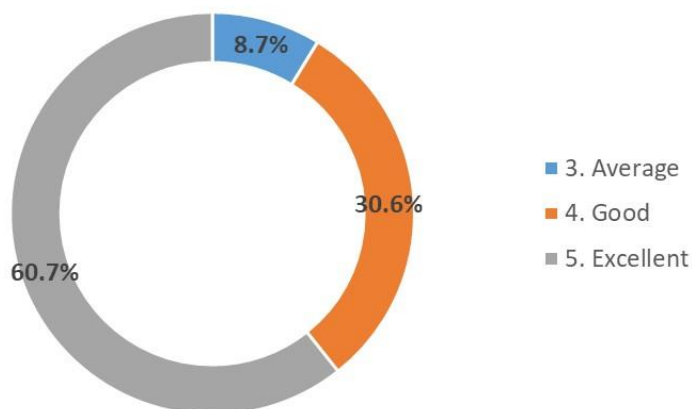
thank God for saving our lives. We prayed to him. (Household No 149 of *North Weralabada*)

Nonetheless, as discussed in Chapter Four, authorities were perceived as being responsible for some of the environmental problems of which people were aware when they listed their main concerns in the early stages of the questionnaire. The major stress of closure of the inlet⁸ provides a good example. In that case authorities were accused of not taking necessary measures to stop a natural process of sand deposition via technical means. However, this problem was there for half a century without any changes as it was considered by authorities simply as an attribute of nature. This has had a huge impact on fishers, with loss of many lives over a long period.

Additionally, the perceived level of knowledge about the natural environment that the respondents live in is also tested (Figure 6.2) to understand the extent to which they are familiar with that environment. This also assists with the validation of the responses made by respondents regarding perceived changes.

Figure 6.2

Perceived level of knowledge about the natural environment



The majority (60.7%) of respondents were confident that they had an excellent ability to read and feel the changes of the natural environment that they live, while 30.6% stated

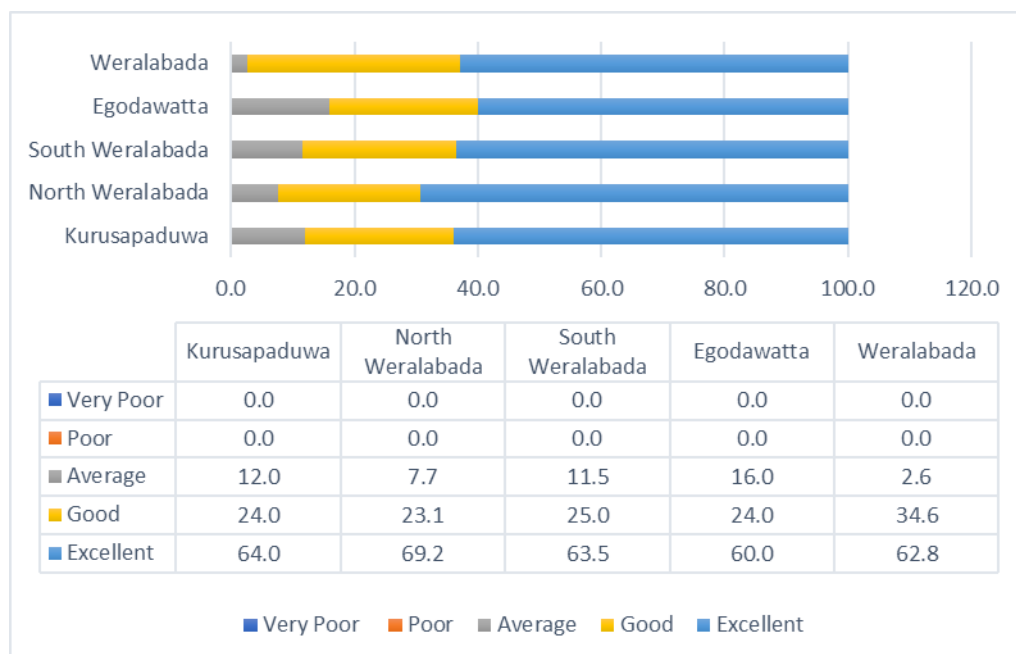
⁸ The inlet is blocked or closed by sand very often which is a natural process. As it works as the gateway for fishers to enter and come back to and from the sea, this is a significant disturbance and also proven to be a great danger. This accounted for a minimum of one death a year. Thus, many fishers have lost their lives so far due to this problem.

that they have fairly good knowledge and ability. None of the participants fell under the categories of very poor and poor. A low percentage (8.7%) acknowledged that they had an average understanding of the environment that they live in, thus they admitted they were less capable than most other members of their community of reading or understanding changes. Despite these different percentages which may be a result of different age groups, all participants have been living in the study area since their birth. It is highly likely that they would notice the changes in attributes of climate in the area as argued by Amos et al. (2015).

When the same variable was compared across GNDs they all exhibited a similar trend (Figure 6.3) except for *Kurusapaduwa* where both good and excellent categories recorded an equal percentage of 44%. For the other GNDs, many of the participants indicated that they had an excellent knowledge of the natural environment in which they lived. The satisfactory level of association with, and understanding of, the natural environment demonstrates that their insights are likely to be valid, meaningful, and useful.

Figure 6.3

Perceived level of knowledge about the natural environment across GNDs (%)

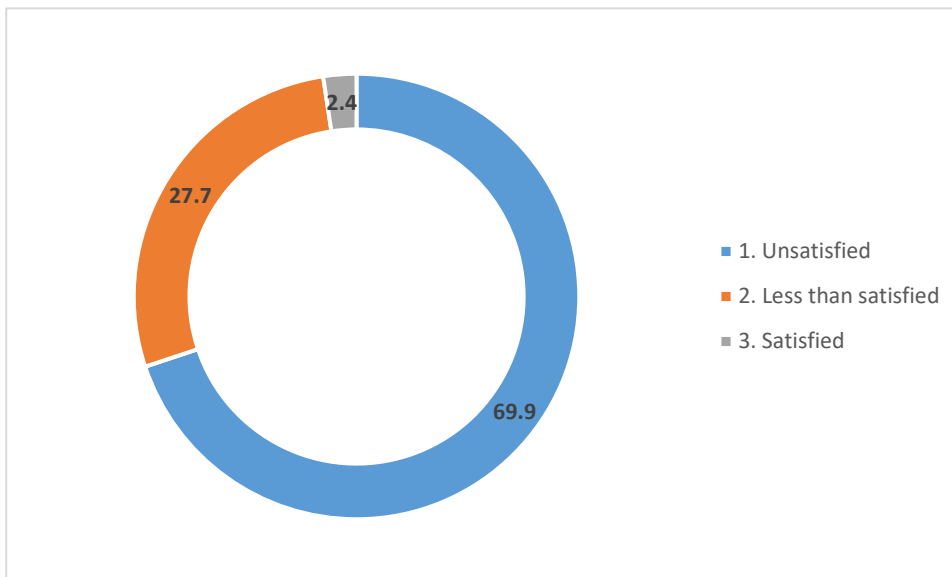


When participants were asked about the level of satisfaction with government responses for what they perceived as major concerns, 69.9% stated that they are unsatisfied (Figure 6.4) with the government approach while the rest (27.7%) stated they are less than satisfied. Similar to the previous case, the perception towards the

government across GNDs exhibits a homogeneity in the responses where more than 64% of the participants in each GND are dissatisfied with the actions taken by the government thus far to resolve the issues they encounter, be they climate-related or otherwise.

Figure 6.4

Perceived level of satisfaction of participants from all GNDs with government responses to major concerns (%)



The extent to which the participants are curious and worried about the variations or abnormalities in the natural environment they live in, was also queried during interviews. As shown in Figure 6.5 (a), 45.6% said “yes”, when they were asked whether they were ever curious to understand the reasons behind the variation in attributes of climate that they noticed. Remarkably, 34% stated that they did not want to learn about the underlining causes of changes in climate attributes while 20.4% had no idea or did not show any interest on the same subject. The view of household No 62 towards the learning of underlying causes of these changes was:

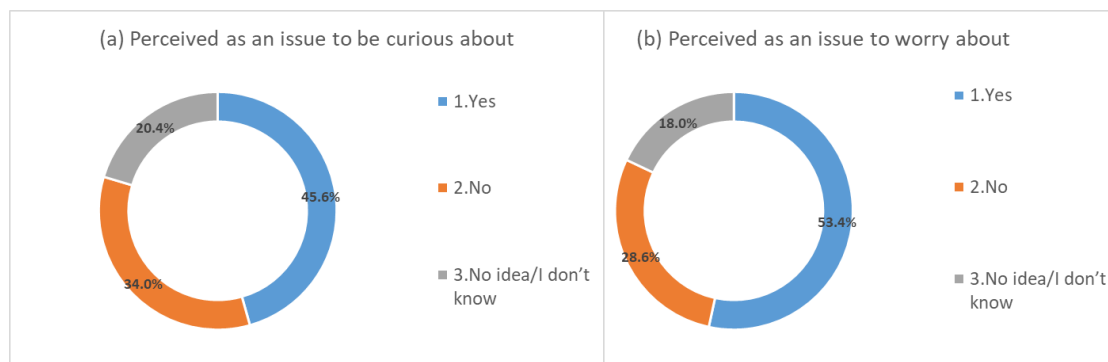
Even if we get to know that, what can we do about it? We only know fishing and we only do fishing. We know everything about fishing. But the rest we don't know. Only God can answer those. So, we pray to him. (Household No 62 of *Weralabada*)

Therefore, the low curiosity manifested by some respondents is likely to be a result of their faith or belief in God or Divine powers. They believe that there is no use in trying to understand those causes as they do not possess the power to control them. This view is also reflected in the participants' opinion about the statement that climate change is mainly a result of human activities to which 32% disagreed while 19.9% neither agreed nor disagreed.

Despite their low enthusiasm towards learning about the subject of climate change, the majority of 53.4% stated they are worried about the changes they noticed in weather, as shown in Figure 6.5 (b), simply because they perceived that these changes affected their livelihoods. Yet, another 28.6% perceived weather changes as phenomena that they need not worry about. The rest (18%) were undecided about the question, possibly due to their limited knowledge about the physical processes that govern the phenomena. Similar conclusions were made by Kuruppu and Liverman (2011) with respect to the feelings of worry and concern in the coastal community that they studied.

Figure 6.5 (a,b)

Climate change perceived as an issue to be curious about (a) and worried about (b)



In contrast to responses to the perceived causes of climate change and their reluctance to learn about the phenomenon, 86.9% (Figure 6.6) stated that they themselves were responsible for initiating actions over the threats brought by climate change. In their view, nobody else would bother to do that when they were the people experiencing it firsthand. Thus, the acknowledgment of their responsibility to act on these changes is partly due to their disappointments over the way they are treated by authorities. The perception of household No 202 clearly demonstrated this disgruntlement:

It is us who suffer, so we ourselves have to find answers. Who else would understand our grief? So far no one. Only God listens to them. Thankful to him we survived this long. The Government never listened to our problems. They give everything to farmers (referred to agriculture), but not to us. That's not fair.

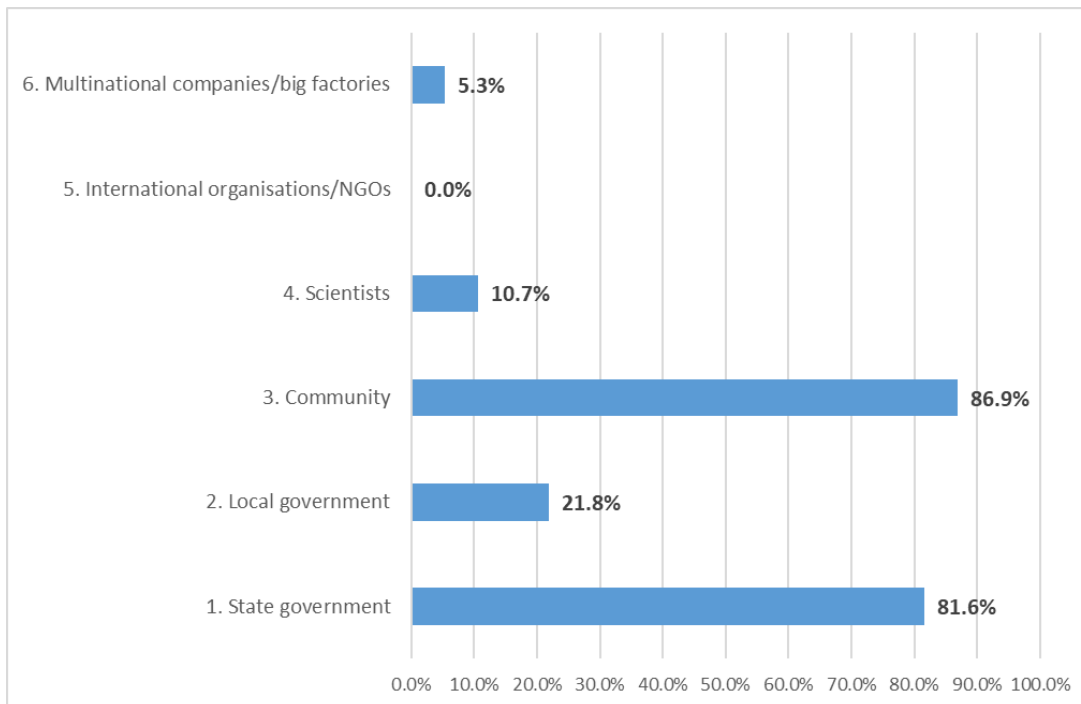
(Household No 202 of *South Weralabada*)

This dissatisfaction was clearly evident in the analysis of major concerns which are discussed in Sections 4.6 and 4.7 of Chapter Four, where a great number of participants in

each GND expressed the view that coastal communities in the country are neglected while farmers are always given priority.

Figure 6.6

Perceived responsibility as to who should initiate an action



Subsequently, 81.6% indicated their belief that the State Government had a big responsibility to assist them with their problems whereas only 21.8% believed that local governments are also responsible. However, the low percentage that tend to rely on local government is likely to be due to the perceived low capacity of their local governments to serve them compared to the greater capacity of the central government. On the other hand, 21.8% believe that the responsibility of local government is to allocate without corruption all the funds provided by the central government for their welfare. Only small percentages perceived that scientists (10.7%) and multinational companies (5.3%) should be responsible for initiating an action. Surprisingly, none of the respondents claimed that International Organisations or/and Non-Governmental Organisations (NGOs) were responsible for initiatives to answer the effects of climate changes. According to the

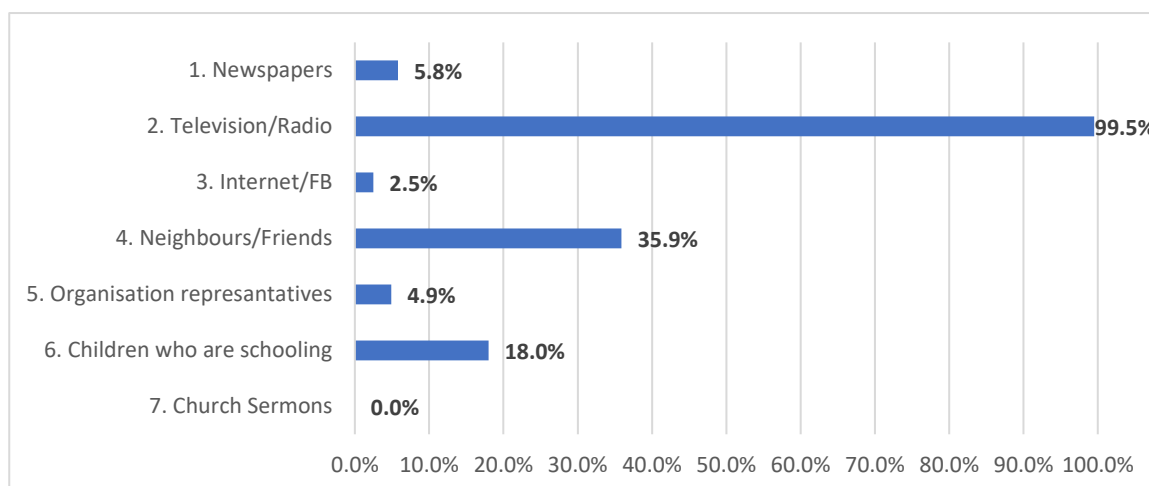
documentation provided by the AGA⁹ office, there were no NGOs/INGOs located in the area under study.

When questioned about the sources of information from they access to become familiar with climate change, the respondents all (except for one person) said they relied either on television or radio for weather-related information (Figure 6.7). The person who did not rely on these media believed that they were politically biased, thus could not be trusted. The significant role of mass media as a source of information in climate change is endorsed by the findings of Buys et al., (2014). They also reveal that some of the trust issues people have with media are attributed to political affiliations as in this case (Buys et al., 2014).

Kasperson and Kasperson (1996) also provide a number of examples that demonstrate the strong influence that the mass media can have on people and their perceptions. However, 35.9% acknowledged that the changes they notice in climate attributes are usually discussed among themselves. Having children at school was evidentially a good opportunity for some to discuss the issues. 18% stated that they listen to children, or else children often shared what they learned in the school such as how things happened and how things are changing around the world. Newspapers do not seem to be popular sources of information in contrast to what Kuruppu and Liverman (2011) found in relation to the coastal community of Kiribati.

Figure 6.7

Respondents' sources of information on climate change (%)



⁹ Assistant Government Agents (AGA) offices are the main body that represent central government in GND levels. They have different officers that represent major department of Sri Lanka. GN also reports to the head of AGA.

It was also revealed that the subject of climate change, particularly its effects on coastal livelihoods, was not discussed during church sermons even though they have been used as a useful platform from which to deliver other messages to a large number of community members. For example, if the AGA office decides to implement a beach cleaning programme, they include this avenue among other official communication channels to pass the message to community. Even many of the discussions related to the matter of “closure of inlet” were held in church premises with the presence of Parish Priest. For these communities he is their most trusted representative. Therefore, the Parish Priests of their respective churches have very strong vested authority. Household No 124 of *Kurusapaduwa* highlighted:

The Rev. Father we had in our church was a very good person. He is personally involved in our village matters. I will tell you one example. There was this family who used to sell alcohol illegally to the community. Alcoholism has been a problem here ever since we were born, actually even before that. Still people drink alcohol. But not that addicted. In the past my great, great grandfather exchanged his deed of the land for a bottle of alcohol. So, you can imagine. Now because of this family I mentioned earlier, it is sort of spreading. So, one day Rev. Father asked us to come with him for a mission. So, we went that house with the Father and took all the alcohol and its producing materials in our hands and stored them in the church. Then, Rev. Father asked them to come to church and swear that they do not involve in that business again. (Household No 124 of *Kurusapaduwa*)

This clearly demonstrates the power of the Church in these areas and its usefulness as a channel for disseminating climate-related information. Meltzoff and Moore (1999), Weber (2010), and Schunk (1987) also demonstrate the power of role models to influence human behaviour. The effectiveness of the church as a channel to communicate climate science to this coastal community is clear.

Taken together, the themes discussed above provide a detailed overview of the ways in which communities perceive and interpret climate change impacts on their environment and livelihoods. The next and final chapter further elaborates the ways in which these context specific perceptions and recognised vulnerabilities shape their adaptive capacity. This in turn will ultimately decide the process of adaptation.

Chapter 7. Discussion and Conclusion

7.1 Introduction

The literature reveals that communities usually realise and define their environment together with associated risks and vulnerabilities with reference to their knowledge and perception, and accordingly develop and improve adaptive mechanisms (Adger, 2006; Burton et al., 2002; Dovers, 2009; Krishnamurthy et al., 2011; Rahman, 2014; Smit & Wandel, 2006; Tran et al., 2009). Therefore, adaptation is not a novel experience for these coastal communities whose livelihoods have been determined by factors of climate since their origin even though their knowledge on the subject of adaptation is limited in its scholarly terms (Adger, 2006). Accordingly, this study investigates adaptation measures already in place together with drivers that facilitate or constrain measures that originate to address livelihood vulnerabilities. Psychological factors, particularly people's perceptions, are recognised and investigated. The study also examines mechanisms and authorities involved in the process of adaptation along with its enabling environment in line with the argument of Daw et al. (2009, p. 137) who states that adaptation has two prime dimensions, building adaptive capacity and transforming those capacities into action. Being an umbrella term, adaptation covers a few concepts, most prominently adaptive capacity, adaptation readiness, and adaptation mechanisms or measures. This study pays attention to all these concepts.

In defining the scope of the enquiry, both autonomous adaptation of an individual or household, and planned adaptation of community groups and formal institutions, are considered in terms of their influence within society and the effect they might have on livelihood vulnerabilities. In this study, long-term responses as well as short-term responses—which often are reactive (Bohle, 2001) and potentially inhibit long-term adaptation mechanisms (IPCC, 2012)—are considered as adaptation. With reference to community and the natural environment it relies upon, two prime adaptation approaches are investigated: Community-Based Adaptation (CBA) and Ecosystem-based Adaptation (EbA).

Being an approach that attempts to mobilise wider community resources, CBA is fundamentally governed by the notion that communities are capable of designing and implementing locally appropriate adaptation measures based on their experience.

Accordingly, CBA is defined as: “a community–led process, based on communities’ priorities, needs, knowledge and capacities, which should empower people to plan for and cope with the impacts of climate change” (Reid et al., 2009, p. 13). On the other hand, EbA harnesses the capacity of ecosystems to buffer their resource-dependent communities against manifestations of climate change. Therefore, this approach gives due recognition to the affinity and connectedness of ecological resources with the surrounding socio-cultural, economic, and institutional systems in place (Midgley et al., 2012) and complements CBA (United Nations Framework Convention on Climate Change [UNFCCC], 2011, p. 4).

This chapter discusses the coastal community practices based on what people believe and what they possess (capital approach/entitlement approach), and the context within which those practices take place. The chapter addresses the third and fourth research objectives of the study and attends to the final section of the main conceptual framework. The argument here, therefore, is fundamentally governed by a political economy approach which interprets vulnerability as a starting point, thus exemplifies the magnitude of ideas and ideologies, power or powerlessness and institutional capacity, and governance in determining respective adaptation actions. (Tanner & Allouche, 2011). Consequently, the chapter suggests that success and failures of adaptation are subject to the social, environmental, cultural, and political realms of societal perceptions, rights, and access to livelihood capitals and to the sensitivity of institutions. Subsequently, it affirms that coastal communities in the selected case do not exhibit novel adaptation mechanisms that specifically address climate scenarios except for a few trends mentioned in Section 7.2, presumably for three main reasons: the lower number of natural disasters take place within the context; the absence of dialogue facilitating understanding of the phenomenon of global climate change; and wishful thinking where the majority believes that everything will be alright in the immediate future. It also stresses that fluctuation of community capital has altered to an extent that it damages the very natural capital that their livelihoods are built upon.

7.2 Practical Implications of LVI and LVI–IPCC

The Livelihood Vulnerability Index (LVI) which was constructed upon eight main components (major sectors) was chosen to assist the main research question (how can a better understanding of the perception and livelihood vulnerability of coastal communities

assist adaptation to offset the effects of climate change impacts?) in several ways. They were stated at the outset and are revisited here for their applicability and usability in the context in which LVI is applied. Primarily, the LVI provides a means of understanding the degree of livelihood vulnerability of these Sri Lankan coastal communities. It provides an entry point to discussions about climate change, which are common in the global context yet proven to be absent in the setting of this research. In particular, the simplicity of the LVI in terms of its formulation and method of calculation addresses the needs of poorly resourced stakeholders seeking a simple method for assessing livelihood vulnerabilities and taking timely action before it is too late.

In line with Cutter (2003), who claims the ability of indexes to estimate and compare relative vulnerabilities, the index facilitates the comparison of the relative vulnerabilities of these five coastal villages and can be used for other similar settings across the Sri Lankan coast and around the globe. The visual representation of the index enables its users to understand the factors contributing to vulnerability more easily and rapidly than if these were presented in tabulated form (Hahn et al., 2009).

The analysis discloses a number of subtle yet important differences between these villages, which are also impacted by urban area (Madhuri et al., 2014; Shah et al., 2013) of nearby Chilaw city, situated within a radius of approximately five kilometres. On the whole, the main sectors or major components of the LVI reflect internal and external disturbances and threats to existing livelihoods; social, political, and economic constituents; power relations; and access to resources. These results are similar to the findings of Adu et al. (2018) who researched access to and utilisation of water resources in Ghana through a Livelihood Vulnerability Index (LVI).

In terms of natural disasters, climate variability, warning, and impacts, six years was the period chosen as the recall window to be more accurate because, I concur with Hahn et al. (2009) and Fowler (2002) that it is hard for people to hold onto memories for longer than that. The Key Informant Interviews (KIIs) that took place before the surveys, however, gave us access to certain recorded data, thus I knew about some of the events that the participants recalled. This gave me the opportunity to discuss these events in a more accurate way. Despite the history, the results clearly indicate that the respondents' low awareness of and negative attitudes towards disaster management protocols are likely to generate large losses during future disaster events. Thus, it is essential to conduct

programmes to educate households of every GND on the subject of disaster management in order to minimise such losses.

Education on financial literacy and other forms of skill training on food processing and preservation techniques that add value to fish and other food, can be a remarkable turning point in livelihood diversification. This can also be an answer for the housewives who have been looking for opportunities to shoulder the financial burden of the households while taking care of their children. Although their harvest is low, householders mentioned that some parts of the country had an abundant supply of fish. A businesswoman running a large-scale dried fish enterprise reaffirmed this by stating that now she had to take fish from more distant areas like Negombo to sustain her business as harvest of fish was very low in the area of study and even abandoned in some other areas.

The households of *Weralabada* diversified their income sources beyond common preferences like driving a taxi (a three-wheeler) or opening a small grocery shop to more sustainable businesses, such as ornamental fish farming, soap making, and printing (wedding cards, visiting cards, and business marketing banners). A relatively high number of members of households of *Weralabada* are employed abroad and in the private sector outside the GND, thus they were not as negatively impacted as other GNDs by contemporary context-specific climate change phenomena. *Weralabada* in particular shows a trend for the members of families who have fished for generations to deviate from that path towards more secure income sources. Over the last generation, households have continually moved in a direction of specializing in singular livelihoods as well, often towards the ones with most certain income. Housemaids working abroad and self-employed women who alter and sew dresses for money provide good examples of this. This resonates with the findings of Shah et al. (2013) who applied the similar form of index to understand livelihood vulnerabilities to climate change impacts in Trinidad and Tobago. The most capable households focus on a diversified income portfolio relying on the available household human power, such as fishing and ornamental fishing. Although in certain cases these income sources do not earn them as much money as their fathers or husbands used to earn from fishing, they appreciate the certainty associated with such occupations while some also mentioned lower risk as a benefit. Despite the amount of earnings, the coastal livelihoods, particularly the fisheries which are heavily stricken by low harvest, demonstrate the need for livelihood diversification.

Kurusapaduwa which was found to be the most vulnerable in terms of health, recorded the highest average dengue fever exposure index, one of the variables responsible for its highest LVI score. During the survey it was found that almost all households possess bed nets yet are not willing to use them because they think it is a discomfort. A few people however reported that they were thinking of buying new bed nets as the old ones were extensively patched and no longer usable. Owing to the limited incomes of those households, this need became a low priority while food and children's education needs were the highest. Ninety four percent of the *Kurusapaduwa* households identified the cost of children's education as one of their major concerns. This inhibited their ambition to educate the younger generation, so that they could find a job with secure and certain income, unlike fishing which is now threatened by both natural and human-made stressors. The higher value on average waiting time in the health facility recorded by *Kurusapaduwa* compared to *North and South Weralabada* revealed that members of the low-income households often go to the public health service during an illness, because it is free of charge.

The highest percentage of visits to local government for assistance (76%) remarkably reduces the vulnerability of socio-political networks in *Kurusapaduwa*, despite it having recorded the highest vulnerabilities in all other sectors, except for water. This high percentage however was found to have a political motivation where many of the people who paid a visit expected something in return for their support in previous elections. Broken promises in politics might also be the reason that 44% of its households did not vote in the previous election. Presumably, the highest percentage of 38.5% of *North Weralabada* residents who stated that they were prevented from getting a job for which they were qualified for political reasons, correlates to the highest percentage of 76.9% who voted during the last election, probably with the intention of defeating the current party. This may symbolise a positive trend in politics in a developing country such as Sri Lanka, where some people blindly follow political parties irrespective of whether they keep promises or not. Conversely, a considerable percentage of people in the study area still disvalue the power of the vote, thus abstaining from voting. The programmes that improve political literacy appear to have a role in this regard to help people realise the power of voting while assisting them to make informed decisions in elections to ensue good governance.

By virtue of its geographic location, *Kurusapaduwa* recorded the highest vulnerability on shelter (0.258), followed by *Egodawatta* (0.180). A large number of unauthorised dwellings together with absence of title deeds prevent people from upgrading their houses and facilities to meet their desires and improve their wellbeing. This put a considerable weight on overall shelter vulnerability. This situation became more complicated with biased political interventions where some of those households were allowed to make alterations to their unauthorised dwellings, while others were either restrained from or punished for making such changes.

The findings suggest that all GNDs except for *Weralabada* lacked basic forms of land title. This demonstrates considerable shelter vulnerability. Shah et al. (2013) also confirm the significance of land title in contexts similar to this as a determinant of residents' vulnerability. This in turn reveals significant structural factors that contribute to the understanding of vulnerability, as it limits the access to formal safety nets and entitlements. It also identifies the direct intervention required of respective authorities to either eradicate or minimise such vulnerabilities which could then have an impact on almost every other sector. For example, the legal ownership of their dwellings will make households eligible for a loan from the formal financial sector that could be invested in a diversified income source or a project that enhances their wellbeing, such as accessing pipe-born water, electricity, or a water-sealed latrine.

The lowest exposure and better socio-demographic profile and health status decreased the overall LVI-IPCC of *North Weralabada*. However, it recorded the lowest adaptive capacity mainly owing to poor social cohesion and unacceptable governance issues. With respect to poor social cohesion, the highest number of people did not take the membership of community-based organisations (CBOs) and did not seek the government assistance. In terms of unacceptable governance issues, the highest percentage of respondents compared to other GNDs, 38%, claimed that they had lost job opportunities because of political influence. In contrast, *North Weralabada* has the lowest percentage of female-headed households and zero percent of orphan-raising households, providing more flexibility in choosing and executing favourable adaptation strategies compared to other GNDs which must endure those competing pressures. Booysen et al. (2004) and Hahn et al. (2009) discussed similar scenarios in relation to livelihood vulnerabilities of systems.

South Weralabada, which recorded the second lowest values for exposure and sensitivity, and second highest for adaptive capacity subsequently recorded the second lowest LVI–IPCC. The best performances in the main sectors of food and socio-political networks contribute significantly to lowering its LVI–IPCC vulnerability. When the subcomponents are examined, having the least number of months during which households struggle to find food, together with their better food utilisation, seem to lessen food vulnerability. *South Weralabada* recorded zero value for prevalence of diseases related to food utilisation and the lowest percentage of underweight children. The attitude of household members toward seeking help from the government and ability to secure loans from a formal bank largely contribute to the overall performance of SPN. Another reason for these better results may be the households’ lowest dependency ratio. This provides them with a secure space to grow with a lower burden which therefore defines how the earned income is distributed.

In line with Hahn et al. (2009), this study produced LVI and LVI–IPCC, the two alternative methods to assess relative vulnerabilities of systems to climate change impacts in addition to the sector vulnerabilities of each GND. While acknowledging vulnerability as a starting point, each method presents a vast array of factors, including climate related threats, lack of skills to adjust to the stresses other than the fishing, poor financial inclusion, and unstable political regimes, that drive livelihood vulnerabilities of the households. This resonates with the findings of Eakin et al. (2014) who stated that generic (“associated with fundamental human development goals”) and specific (“those necessary for managing and reducing specific climatic threats” (p. 1)) capacities are fundamental to adapt to climate change. As Vincent (2004, 2007) claims, it also helps to understand how shocks in a given system alter its functionality through spreading its impacts. For example, production shocks (decline in harvest) are conveyed in the socio-political (average receive: give ratios) and economic domains (low income and livelihood diversification). Similarly, it reveals how human encroachment in floodplains is associated with flood losses, the main reason for the highest recorded value on exposure for *Egodawatta*. Rodima–Taylor et al. (2011) reaffirm this relationship with loss and the geographical location of the systems. As argued by Ribot (2010, pp. 50–51), understanding vulnerability in the context of a “wider political economy of resource use” enables the discovery of stresses and mechanisms to

overcome them within the system itself rather than depending on excessive external interventions.

In other words, the findings demonstrate the need for immediate intervention on poorly performing sectors through which livelihood vulnerability can be reduced, while it also implies the importance of maintaining the functions that are responsible for relatively low vulnerability sector values. For example, *Egodawatta* displays the need for strategies to lower its Livelihood Assets and Practices (LAP) vulnerability while the figures on *Weralabada* indicate that it should focus on either continuing or promoting practices relating to that same dimension of vulnerability (LAP). Evaluating further, the findings reveal that the number of factors associated with *Weralabada* which made it the least sensitive to climate change impacts can also be employed by other GNDs. They are: low prevalence of chronic illnesses; dengue fever prevention measures that are in place; proper access to sanitary facilities; enhanced food availability and food utilisation practices; and satisfactory level of housing conditions. The highest adaptive capacity is also recorded by *Weralabada* as a result of certain practices in place, mainly livelihood diversification and innovation. For example, these residents apparently choose to be innovative by starting sustainable businesses, such as: mobile vegetable selling, where they collect vegetables from local sellers and then take them to distant rural villages selling them with a profit margin; soap production; ornamental fish rearing; printing shops that print cards for all occasions; beauty culture related services; sales representative opportunities; and tuition classes. In addition, a considerable percentage of the women of *Weralabada* GND already work as housemaids abroad. Apparently, they seem to initiate this as a process and make it popular among other GNDs.

Similarly, the community's vulnerability to food is proven to be a direct effect of decline of harvest where almost all its members rely on the external market for their food supply, which is determined by their purchasing power. Most households showed willingness to maintain a home garden yet complained about their inability to do so due to the salt laden wind (*lunu kasuwa*) in the area that either hinders or terminates plant growth, particularly during periods of strong winds. Others, especially women, stated that their daily routine which involved both household duties and livelihood support activities was the reason for not maintaining a garden while for some the reason was the limited space available. Even though the Government initiated several programmes to promote home gardening mainly

through distributing seeds, they failed in this context due to people's lack of agricultural knowledge and lack of innovation to overcome the difficulties people faced, such as limited space and wind full of salt (salty sea spray). This ability of the LVI in selecting the points of intervention to combat potential impacts of climate change (Eakin & Bojo' rquez–Tapia, 2008) further increases its usability and applicability.

The LVI enables the measurement of the effectiveness of such interventions by identifying the change in figures that they generate on respective indicators, sectors, and finally on the LVI. For example, authorities can improve livelihood diversification by introducing more livelihood options to the communities. These options can be then assessed through before and after calculations of Livelihood Assets and Practices (LAP) and LVI. Subsequently, the indirect effect of interventions on other main sectors (such as on food and socio-demographic profile) can also be evaluated to understand the broader positive and negative impacts on these communities, which in turn would assist resource prioritisation and sustainable programmes. Also, substituting the values of different indicators and then recalculating the LVI to see the effect provides the benefit of projecting the results beforehand. For example, a value could be substituted to “the percentage of households without electricity” and the sector vulnerability and LVI could be recalculated to understand its effect.

However, these interventions need to focus on traits of coastal livelihoods, which bring into force the third benefit of LVI. The LVI accords with current best practice by adopting a sustainable livelihood focus to examine the dimensions of both vulnerability and adaptation (Simane et al., 2016). Thus, the LVI encompasses the factors relating to natural, human, financial, physical, and socio-political capitals which shape the behaviour of rural communities (IPCC, 2007). These can be addressed to lower their sector vulnerabilities, and thereby the overall LVI. The findings identify the contributory factors of each GND that have shrunk the asset pentagon of households and increased the relative sector vulnerabilities.

Similarly, the LVI also shows the factors that strengthen the asset pentagon of the households from the five villages. This suggests the significance of either maintaining or improving those factors in order to keep the LVI of each village within a healthy range (in 0.3 or below). The index facilitates the incorporation of context-specific factors as demonstrated in Figures 5.4 and 5.5. This is one of its several advantages for addressing

local vulnerabilities which are often overlooked by climate models and are not permitted by some other assessments (e.g., O'Brien et al., 2004; Eakin & Bojorquez-Tapia, 2008). Despite focusing on climate projections, the LVI approach assesses the strengths of the prevailing social conditions to withstand the pressures generated by climate and nature-related stresses while it also recognises the competency of the intended systems to adjust.

Besides, the LVI facilitates policies that consider households' past and present experience, thus is different from the proposals built upon climate scenarios which often envisage a fictive future that is distant to communities. This aligns with the theory of Ingold (2007, 2012) and argument of several other scholars (e.g., Baron & Petersen, 2015; Leyshon and Geoghegan, 2012) who claim the need for policies to take on measures that somehow have affiliations with past experiences and present circumstances of the communities for whom they are intended. With respect to that aspect, the study (Figure 5.4 and 5.5) provides a basic guideline for authorities about what to focus on, and what not to, when prioritising and implementing successful policy measures.

Overall, the high dependency on fishery and its associated livelihoods together with people's tendency to stay within the community itself despite seeking opportunities outside the study area makes these villages highly vulnerable. The dependency on money lenders for people's main livelihood also curtails their income, which in turn affects their savings and investment opportunities. In fact, the financial assistance which is usually available for them at a very high cost, such as from village money lenders and unregulated microfinance institutions, hinders their progress in improving their livelihood, as well as their wellbeing. Closer examination reveals that these hostile practices are found to be prominent in some GNDs (e.g., *Kurusapaduwa* and *Egodawatta*), while some other GNDs (e.g., *South Weralabada* and *Weralabada*) have somehow managed to escape them, resulting in differential vulnerabilities and uneven capacities.

The ability of LVI-IPCC to represent these uneven capabilities of GNDs to prepare and respond to climate-related impacts provides a useful benchmark for assigning resources required to compensate for the different levels of vulnerability. It also enables the understanding of the transformation of livelihood vulnerability of the same community over time. Additionally, the comparisons across similar coastal settings can be performed simply by inspecting their vulnerability spider (Figure 5.2) and triangle (Figure 5.7) diagrams, providing similar methods are employed. Overall, the LVI and LVI-IPCC assess

vulnerabilities and capacities primarily based on what is in place or the objective ability of the communities. As Grothmann and Patt (2005, p. 202) argue, people's "objective ability" can be very different from their "subjective ability", thus emphasising the importance of including psychological dimensions in vulnerability and adaptation science. Besides, Gifford (2011) argues the importance of identifying psychological barriers that impede behavioural choices in the process of adaptation in addition to recognising the climate-averse structural barriers.

7.3 Contextual determinants and dimensions of perception

This aspect of the study investigates the perceptions about climate change of the inhabitants of the five coastal villages by means of a quantitative scale. It also measures the way in which households interpret phenomena related to climate change and the ways in which these interpretations are transferred into their behaviours. Specific formulae for calculating the Perception Indexes (PIs) were designed to be straightforward in order to be accessible to a diverse set of users. The opinions are investigated in relation to two groups, fishery and non-fishery, to understand specificities and possible differences. Ultimately, it needs to be realised that cognitive barriers exist within households to overcoming the vulnerabilities of climate change and understanding the avenues to increase the people's adaptive capacity in order to combat the impacts of climate change. The conceptual model and its formulation are detailed in Chapter Two and Chapter Six of this thesis.

Five main segments that characterise dimensions of perception upon which perception indexes are constructed are examined. They are: attitude and level of awareness on climate change impacts; understanding of its causes; community's familiarity with and experience of its impacts (perceived exposure); perceived sensitivity; and perceived adaptation efficacy and self-efficacy (perceived adaptive capacity). The theory of Ingold (2007) is followed to understand the views about climate change which is often interpreted in terms of weather. The Sinhalese term for climate change (*deshagunika wiparyasa*) is a formal word which is absent in the local dialect of these communities where they often interpret the change in relation to the attributes of climate such as temperature, wind, rainfall, and sea currents.

The 5–point Likert Scale takes a ranked value of 1 if a respondent strongly agreed to a perception statement, 0.5 if they agreed, 0 if respondent is undecided or states “I don’t know”, – 0.5 if they disagreed, and –1 if they strongly disagreed. Accordingly, the statements of each index are designed to reflect the negative mean values with negativity and positive mean values with positivity in relation to adaptation. Consequently, positive mean values imply positive contribution either to improve adaptation or to reduce vulnerabilities whereas negative mean scores demonstrate negative effect on them. In other words, the positive mean values demonstrate the majority’s agreement with the statements that question the five dimensions in relation to climate change while the negative mean values exhibit their denial as detailed in Section 6.6 and 6.7. Similar to the LVI, the statements are constructed to capture exposure, sensitivity, and adaptive capacity of the community based not on what they possess and what systems are in place, but rather on how they perceive the existing realities.

As shown in Figure 6.1, five perception indexes (PIs) reveal the tendency to stay either close to neutral point (0) or below (towards –1) which implies poor perceived levels of exposure, sensitivity, and adaptive capacity. Therefore, the results clearly reveal the cognitive barriers that exist within these communities to respond to climate change impacts. They neither believe they are capable of absorbing the associated risks (perceived sensitivity= –0.156) nor that they can recover from them (perceived adaptive capacity= –0.329). They are not certain of the degree of exposure (perceived exposure= –0.068) that they encounter as reflected by the recorded negative mean value for the respective PI. Perceived attitude and awareness and understanding of causes which can also assist adaptation, recorded contradictory PI values of 0.043 (positive) and –0.158 (negative), respectively. As reflected by those values, the community seems to perceive the phenomenon of climate change as real in their own terms (0.043) although their knowledge as to what it causes is proven to be very limited (–0.158). This could impede future climate-related adaptation measures. The ways in which the constituents of these five PIs contribute to identifying barriers to adaptation as well as to clarifying the avenues to increase adaptive capacities are outlined below.

When the impacts were investigated in relation to the way and the extent that they are felt by the community, four main changes are found to have attracted the attention of the majority of participants. Accordingly, the community acknowledges the existence of and

their exposure to climate conditions that are manifested by decline in fish stock, increase in atmospheric temperatures, anomalies in wind direction, and increase in intensity of lightning among many other impacts that are found to have associations with climate change. This inquiry of perceived exposure suggests that the community tends to perceive impacts in relation to the extent of damage that they could cause either to their livelihoods or wellbeing regardless of other impacts in the area. For example, they admit the impact of climate change on their fish stock and distribution yet deny the existence of sea level rise (SLR) and erosion, the two main impacts that are discovered to be most evident in the area. In line with the findings of Zahran et al. (2006), the planned adaptation of cultivating pandanus palm trees (*Wetakeyya*) as a barrier to strong wave was not a successful project, because the community did not perceive natural disasters like tsunami as a threat. This was because of the minimal damage caused by the 2004 tsunami to this area compared to the devastation it brought to the southern and northern areas of the country. This situation also resonates with the argument of many scholars (e.g., Baan & Klijn, 2004; Keller, et al., 2006; Loewenstein et al., 2001; Messner & Meyer, 2006; Weber, 2010) who claim a relationship between communities' perceptions with their experience.

The perceived ability of the community to absorb the effect of such impacts is also investigated through their perceptions on access to food, water, shelter, and health facilities. Alarmingly, three quarters of the residents stated that their food security was already at risk owing to the decline in harvest that directly reduced their purchasing power. More than half of the residents expressed the belief that the prevailing water resources and health facilities would not be enough to combat impacts about which they were concerned. Around 42% of the participants believed that their dwellings were at risk not because of sea level rise but because of legal issues related to land occupation and ownership which will become important in responding to climate change impacts. In sum, their responses to the questions related to food, water, shelter, and health indicate that they believed that they were not in a position to absorb any climate-related impacts on those issues. These perceptions however created contradictory movements in terms of adaptation: both physical and mental distresses caused by these impacts persuaded them to pray often while it also made them realize the need to adapt.

The perceived adaptive capacity is then examined based on livelihood capitals. Despite the perceived higher human skill, every other capital seems to shrink the communities' livelihood asset pentagon (Section 7.5), pushing their perceived adaptive capacity to a lower level. Even though they are confident of their skills and believe that they are fit to work, the skill of fishing no longer can be considered a strength in a situation of diversification and is not in demand owing to decline in harvest. The awareness and knowledge, which have a direct relationship with adaptive capacity, are also assessed to understand the psychological processes that can interfere with effective action (Gifford, 2011; Leiserowitz, 2007). Li et al. (2017) claim that the power of awareness alone can stimulate adaptation actions.

Even though the positive PI of attitude and awareness suggest their recognition of the existence of the problem of climate change, which symbolises a positive contribution to adaptation, these communities do not attribute these impacts to that global issue, simply because they are unaware of it in scientific terms. Despite the country having initiated actions on climate change impacts in 1991 with the development of its National Environment Action Plan in parallel to the United Nations Framework Convention on Climate Change (UNFCCC), and having added many plans and policies to the national agenda thereafter, not a single participant was aware of the existence of such instruments.

This is further affirmed when the participants were questioned about the causes of climate change. Only one person was aware of the term Greenhouse Gases (GHGs) while 85% of the people were dubious or did not know whether fossil-fuel burning and deforestation contribute to the change in climate. Conversely, around half of the participants (47.6%) believed the change is a result of human activities even though they said that they have no idea about what such activities are. Therefore, their view may be associated with God whom they believe has the power to punish humans for what they do. Thus, their opinion about humans' accountability for climate change does not emerge out of knowledge on the subject of climate change, but through a complex worldview associated with the phenomena of good and evil and the power of God. Overall, this clearly reveals that the common scholarly term of climate change is not familiar to these communities, not because that they do not experience the change but because they have neither been educated about the phenomenon nor been included in decision-making

processes. The detection of this colossal gap between the knowledge available (scientific knowledge) and what these communities know, suggests that a proper channel of mediation is essential to educate people on the basics of the causative physical processes of climate change. It is too often assumed that these causes are known by the public at large. Cutter (2003) also argues the significance of putting science into practice to utilise its discoveries, and that people need to understand the issues before they can act upon them.

Similar findings were revealed by Kuruppu and Liverman (2011) in relation to Kiribati, a coastal community in a developing context where the advancement of scientific findings of climate change was poorly reflected and the community demonstrated a low level of concern about its impacts. The findings from this study also resonate with research by Baron and Petersen (2015) and Hasan and Nursey-Bray (2018) who claim that their respondents in Bangladesh were unaware of the basic science behind the changes they experienced. They further describe the propensity and practice of those communities to affiliate such impacts with their local knowledge and faith, similar to the findings of this case study.

The major concerns of the community are also investigated to understand the weight they put on climate change impacts among many other common issues, such as pollution, habitat degradation due to over-exploitation, and poor governance. Also, in relation to weather, such concerns vary between the fishery and non-fishery groups of people. The results reveal that environmental concerns encompassing climate change impacts have become one of their major areas of concern, even higher than the issue of social problems. This is favourable for effective climate adaptation. However, economic and political issues appear to dominate their anxieties rather than the stresses that the environmental, social, and professional (fishing) factors initiate. Further, this research shows that fishery and non-fishery groups have similar major concerns even though the priority they place on each is different. Accordingly, the fishery group in all GNDs identifies the closure of the inlet, variable income from fishing, the cost of food, destructive fishing methods, poor law enforcement, and bribery and corruption as their issues of greatest concern. The non-fishery groups from all GNDs perceive lack of mobility during a disaster, the cost of food, the cost of children's education, and pollution of the lagoon as their main concerns. Two major issues are commonly claimed as a priority for both groups, namely

their communities being abandoned, with agricultural farmers being given priority over coastal communities and the decline in fish stock.

When asked to rate the knowledge about the natural environment in which they live, participants demonstrated their engagement with the setting and their position with regard to the change that they speak of. Accordingly, the vast majority declared that they had excellent knowledge of the environment that they live in thus they could perceive and fairly reflect on its changes. This validates their perceptions in that regard. The actions taken by the Government to address the natural distresses they endured were appraised only by 2.3% of the residents, while the rest were either less than satisfied or unsatisfied. However, when the people who were satisfied with the Government were asked what acts of government they appreciated most, they could not point to anything other than the fuel subsidy. This small percentage (2.3%) compared to the larger majority of 97.6% who were dissatisfied and less than satisfied with government initiatives therefore may reflect political affiliation towards the party in power than paying attention to the situation in question.

Responses to the inquiries about the curiosity and worry participants extend towards the phenomenon of climate change are expected to reveal the space available for programmes to impart knowledge on climate change. Mainly owing to faith in God, only around 40% stated that they were curious to find out about the phenomenon of climate change. However, more than half of the residents considered it to be a situation they should be worried about, presumably owing to livelihoods being lost because of its impacts. However, Weber (2006, 2010) characterises worry as a finite resource characterised by people's inability to exercise worry about many issues all at once, so it is necessary to manipulate it with caution. For example, the increase of worry about climate change impacts may lower the perception of risk with regard to social security concerns. This is of paramount importance to open access fishery.

In terms of communication, television was found to be the most popular media from which people gathered data in relation to attributes of the climate while the informal communication between neighbourhoods also seemed to play a critical role. Interestingly, about one fifth of the participants acknowledged conversations with their children who are being schooled as a good source to gather information on many new things and recent trends. The Church, which is one of the most popular and strongest communication

channels in the area, has never been used as a source of knowledge on climate change. However, the role it could perform to educate these communities in relation to climate change seems to be enormous owing to the trust that the community places in the church and its parish priests. It may be challenging to work on both science and faith, yet this is recognized to be a significant requirement in this context. In particular, scholars argue the power of social decision makers to influence human behaviour (Schunk, 1987), because human development is largely attributed to observational learning and imitation (Meltzoff & Moore, 1999) as people construct implicit rules and role-related obligations (Weber, 2010). The section below further illustrates existing psychological barriers to adaptation and potential avenues for overcoming them.

7.4 Characterising Adaptation: Psychological and Operational Perspectives

All respondents from the sample in the study area have been living there for several generations, thus they referred to both personal as well as collective memories which were retold by their relatives to elaborate on certain attributes of climate. For example, household No. 121 of *Kurusapaduwa* explained how everything is different today from what was in the past, referring to his and his forefathers' experience:

Everything is different today. Not only climate, not only the sea. People also are different. My grandfather told me how he and his father used to forecast weather precisely before going to the sea for fishing. They told us, at that time there was a pattern that you could see in everything, rain, wind, sea waves, type of fish available during certain times, so everything. But now even with the technology these people can't predict weather. On TV they say it would rain today and then the whole day turns out to be a sunny day. Pattern that our forefathers told us gone now. So, this is what we have now. And we have to live with it. (Household No. 121 of *Kurusapaduwa*)

Similarly, the findings of Musinguzi et al. (2016) acknowledge the ability of natural resources dependent communities like fishers to recognise the changes in their local climate. Like the above resident, the majority believe "the change" is the "new setting", so that they have to live with it. Most importantly, when they state, "live with it" it doesn't seem that they always refer to the importance of adaptation to the "new setting", instead it signifies the acceptance of the current situation as it is, with the underlying hope that it

will end soon. Despite their acknowledgement of the change, the majority do not relate it to global climate change, which is shown to be a distant and abstract concept for them. This also resonates with the findings of Finucane (2009) and Rahman (2014). Likewise, the study reveals a number of psychological barriers to adaptation (Figure 7.1) that this section elaborates.

Figure 7.1

Psychological barriers of the coastal community to climate change adaptation

Psychological Barriers to Adaptation

- Do not relate “the change” with the phenomenon of climate change as it is proven to be an abstract and distant concept
- Tend to interpret climate change according to the risk or risks that is/are most familiar (e.g., increase in temperature) to them
- Propensity to assimilate observations into a prevailing schemata of a similar type of distresses particularly in the absence of well-defined schemata for climate change (e.g., seasonal pressures)
- Absence of narratives related to climate change where in some other parts of the world broad narratives around climate change suggest that it is a grave threat to humankind
- Inclination to associate impacts of climate change and its causes to invisible powers and wishful thinking
- Understanding of the natural world seems to be a combination of both environmental knowledge and cultural beliefs
- Inability of the naked eye to capture the physical processes of climate change creates doubts about its existence
- Valuing the independence that they have in fishing and pride associated with its risky endeavours
- Strong affiliation to the social bonds that they have been enjoying for generations in their ribbon like settlements often surrounded by family, friends, and relatives
- The centuries’ old accumulated knowledge of resource users which is often referred as anecdotal is challenged due to uncertainty and disruption of lifelong patterns in weather
- Climate change not listed as a main priority where contemporary political and economic factors were allocated the highest priority
- The limited knowledge or understanding of those people of the ways they could change without always depending on fishing or its associated livelihoods
- The firm belief that they don’t possess any other skill other than fishing, thus the preference to stay with the status quo
- Unwillingness to follow future warnings and evacuation procedures

The fact that people have not experienced many traumatic natural disasters explains this languid acceptance of the change to an extent and infers their low level of perceived exposure to the threats. The majority in general do not perceive several impacts of climate change as threats to their livelihoods. They recognise four main impacts: anomalies in the sea, mainly the decline in fish stocks; increase in atmospheric temperature; anomalies in wind direction; and increased intensity in lightning (as shown in Table 6.4). However, in forming attributions for the observed changes, participants found it simpler to conceptualise the climate crisis in relation to the threats with which they are most familiar. Said otherwise, they tend to interpret climate change according to the risk or risks that is/are most familiar to them. Kuruppu and Liverman (2011) and Le et al. (2016) reported similar findings in the contexts of Kiribati and Vietnam, respectively. Accordingly, for some participants climate change is the “increasing temperature” while for others it is the “intensity of lightning” or even both. As household No. 6 of *Weralabada* stated, “I don’t know about climate change. All I know is temperature is increasing. And it is unbearable and unusual” (Household No. 6 of *Weralabada*).

Accordingly, the respondents’ propensity to assimilate their observations into a prevailing schema of similar types of distresses particularly in the absence of well-defined schemata for climate change (Kuruppu & Liverman, 2011) is clearly evident in our study results. Many of the variations in fishing seasons such as anomalies in wind, decline in fish harvest, irregularity in the starting and ending dates and periods of fishing seasons, and strange behaviours of the sea are attributed to the already existed schemata of “seasonal pressures” instead of to climate impacts which are likely to be the real reason. Milne et al. (2008) also arrived at similar conclusions in a study which examined perceptions of drought and climate change of Australian farmers, many of whom linked droughts with local stresses but not with global climate change.

Consequently, as “the change” that they perceived in weather brought them negative effects, around half of the respondents seemed to worry about it while around a similar percentage demonstrated an interesting understanding of the underlying causes of the change despite the belief of the majority that God and divine powers are the cause. In a similar argument, Kuruppu and Liverman (2011) claim a relationship between perceived severity and the extent to which the respondents worry about the impacts of climate change. However, in attempting to relate objective or physical livelihood vulnerability with its perceived measurement, I also related perceived sensitivity in the study with communities’ perceived level of access to food, water, shelter, and an available health facility in addition to perceived level of worry. From that

perspective, the community in general disagrees that they have secure access to those elements, which basically determine their ability to absorb risks or to decide upon the extent to which they are likely to be damaged by the threat.

Speaking of the causes of climate change, the respondents' understanding of the natural world was proven to be a combination of both environmental knowledge and cultural beliefs as argued by Finucane (2009) and Artur and Hilhost, (2012). Close examination revealed various beliefs in that regard (Table 7.1). God, divine powers, and the power of nature appear to be the most accepted perceptions as the causes of climate crisis (Kuruppu & Liverman, 2011; Patt & Schroter, 2008; Petheram et al., 2010; Postman & Murphy, 1943). Although their conversations include the notion that human actions can affect climate, they do not adequately describe how this occurs. King et al. (2008) claimed similar findings where they found implication of human actions on climate in the narratives of tribal elders in New Zealand despite their strong belief in God and divine powers. On the other hand, participants who perceive climate change as a result of the natural processes possibly confuse "climate" with the "weather" that they are well acquainted with, which is in line with the theory of Inglood (2007). The respondents who believe in climate change considered the phenomenon as a local matter, but not as a global crisis. Thus, one of the most famous phrases in the current global climate crisis "think globally and act locally" which motivates climate-related action is unrelated to and not applicable in this context because almost all participants of the study were unaware of the global climate crisis despite being victims of it.

Table 7.1*Perceived causes of the change*

Coded category	Examples
Natural Process	"I think this is all part of the nature. It changes the same way that people change. Sometimes, fish catch become low when there is flood. But again, flood is kind of natural. We can't do anything about it. Can we control rainfall, can we control temperature outside? Inside we can, by using a fan all day long. But outside you can't. It is same with everything, wind, tides everything. It is all part of the nature"
Divine powers	"Oh, that we don't know. How do we know? The God only knows what is happening."
Destructive fishing methods	"That is all about these destructive fishing methods. We don't do that, but our neighbours and Muslims come from Kalmunei do that. Because, for them this is a temporary job. If you go to "Karukkupane" (a neighbouring village) now, you can see the damage they cause to the sea. They brought all corals (<i>GaIMal</i>) with their nets that have been banned for years. Still, they use these nets. We complained to everybody. And finally, as no one responded we ourselves went and caught all those nets and burned them. But after that they began to clash with fishers. They dragged one of our fishers and hit him. When they bring everything here where do fish live. One of the officers introduced by fisheries told us it took at least six years to grow that kind of coral. And they used dynamite to kill fish. That is an utter waste."
Pollution	"No matter what, these people throw garbage to sea. It is not us who live along the beach, but people across the road bring all their garbage and throw it here. I think fish can't live here anymore. They might have gone to " <i>Diyamba</i> " (far away). Actually, there is a huge mountain of garbage in the sea. Some even saw that"
Consumerism	"I think this is how the mother nature answers for what people do. They cut tress. And made things. They reclaimed the lagoon and build something. See how many boats we have here. We used to have a good fish and prawn catch from the lagoon. Now you can't eat that fish. All taste kerosine, because all the boats landed here in the lagoon. So, we always take something from her without giving anything back, at least looking after her properly. We experienced two tornados which we never saw earlier in the land. And lightning, it is scary. We used to love rain and lightning when we were kids. Now we do not go outside when it rains. Nowadays people love things, but they don't look after who give them that"
Combination of drivers	"I don't know the causes. Actually, I feel it is everything. People do bad things and the nature or God or whoever looking after the natural environment is punishing us."
Denial	"I don't see much of a change. Fish catch become low during some periods. I think this is one of them. The only thing is it may be little longer than it used to be. In the past this was the same. Now that people use all these electronic devices, and they think of all possible causes when something just go wrong."

The inability of the naked eye to capture the physical processes of climate change also appears to be one of the reasons for the doubts they have about its existence. The slow onset nature of climate impacts seems to reinforce this form of perception further, as this community does not encounter life threatening events often other than occasional floods. Similarly, Li et al. (2017) argue that more observable climate related phenomena stimulate people's belief in climate risks. Consistent with that argument, the comment of household No. 82 of *Egodawatta* below illustrates why people are reluctant to accept the reality of climate change which may also explain the reasons for low adaptation intentions prevailing in the study group:

We can't see any of those air or whatever the gases these people talk about. So how can we be sure of that sort of processes? All these are not new challenges for fishers like us. I know it rocked to the bottom. But I think these are sort of seasonal things. I don't think even the people who learned about so called climate change can understand that clearly. If they can, why this weather report in TV is always wrong. It is the God we believe. We can't see, but we feel his existence. Anything other than that is beyond our capacity to judge. (Household No. 82 of *Egodawatta*)

This finding was further strengthened by an event which took place in Negombo, another major coastal city that has a close relationship with the Chilaw coastal city of Sri Lanka. A local forestry officer was condemned for her effort to preserve an area of mangroves from some of the fishers in the Negombo area, who, with the support of a State Minister, demanded a playground be built on that forest reserve. As she explained the ecological importance of those forest reserves, she explained the production of oxygen when a fisher questioned the forest officer by asking: "Why we need oxygen? To eat?". He did not understand the term "oxygen" and its significance (Ranawana, 2020). Even though this poor environmental literacy of fishers and the associated State Minister created a huge debate afterwards, it exemplifies people's lack of knowledge of basic science in these areas, combining with the power to demand destruction of natural resources with the support of political leaders.

However, when it comes to adaptation intention, there is little variation between different GNDs and not many people showed enthusiasm for change despite agreeing with the statement that they must adapt. One of the biggest constraints that influences such a low level of adaptation intention is linked with the pride and independence that they have

in fishing in addition to other cognitive and objective barriers that exist within individuals.

One participant reported that:

You know, we don't have a boss. When we want, we go and fish. We love the freedom we have in this job. It is just the sea and us. I don't think I can ever be able to follow someone's commands. It is true that we have hardships. But there were good days. And hopefully, future will be good too. (Household No. 145 of *North Weralabada*)

The belief in divine powers gives them constant hope that "everything will be okay" and allows them to continue as they have been doing for the past 10–20 years, thus limiting the motivation for adaptation. This inclination of the study group to associate impacts of climate change with invisible powers however seems, on the positive side, to lessen their psychological stresses but, on the negative side, seems to dilute their responsibilities. Obviously, according to them the supernatural powers are beyond their control. Thus, this has led to wishful thinking, an avoidant maladaptive behaviour (cognitive phase) and short-term adaptations (action phase) that will eventually turn into maladaptation as also warned by Smit and Wandel (2006). When they acknowledged that they were the people who should initiate an action in the event of climate change, they referred to the action in terms of impacts only, without considering the causes of such impacts in the first place.

For example, some fishers have increased the number of fishing trips and even at times a few of them use illegal fishing gear with the hope that the distress would end soon. These behaviours will eventually deteriorate the very natural resource (by means of juvenile fish catch and damage to fishing habitats) that their livelihoods are built upon. These short-term adaptation responses which are driven by hope rather than by knowledge of the causal factors and associated real impacts have limited their adaptation efficacy and self-efficacy beliefs. In other words, their ignorance of the physical processes behind the changes they perceive either in the ocean, atmosphere, or the land, prevents them from initiating climate impact–related adaptation and even at times promotes maladaptation. However, this portrays one side of the story. On the other side of the story, it is clear that communities, especially the ones that rely on natural resources for their livelihoods, are aware of the changes occurring in their environment together with associated risks and vulnerabilities and develop and improve coping mechanisms accordingly (Krishnamurthy et al., 2011; Rahman, 2014; Tran et al., 2009).

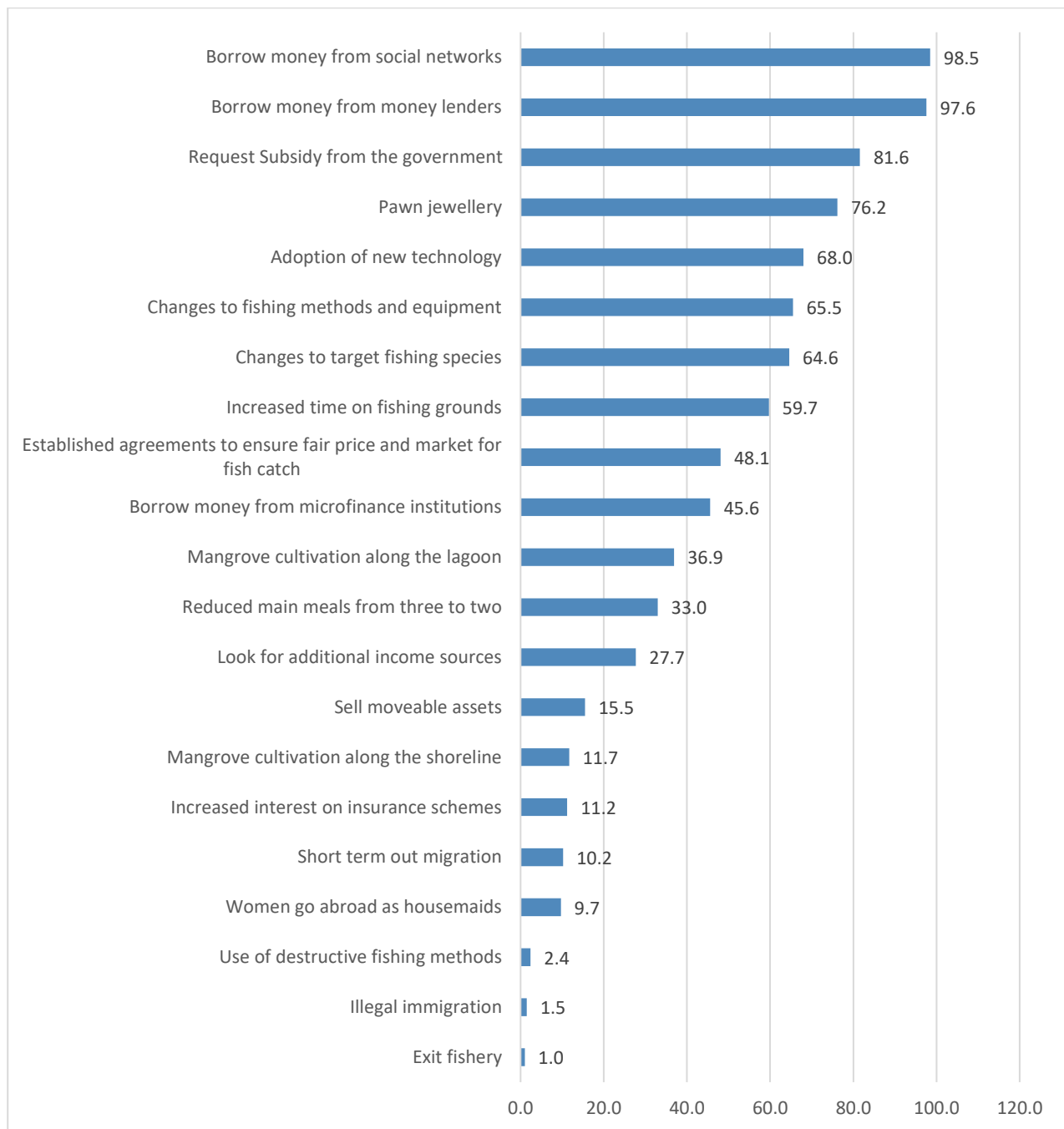
Therefore, adaptation is not a novel concept for these coastal communities. They have responded to challenges, such as seasonal variations in fish catch, floods, and market fluctuations and variations in income through a range of measures. Hence, not only did they respond but they also learned from them. Figure 7.2 clearly articulates the most common response strategies that the residents of these five villages practised, with respective percentages. Additionally, similar to the findings of Gaillard (2010), there were a few other responses that they exhibited during a crisis time, such as praying more often, postponing celebrations like Christening, and missing loan instalments. Adaptation has likewise become a part of their habitus. Yet, as climate change brought new endeavours that go beyond such cognitive frameworks, previous learnings and experiences were proven less capable in managing those (Adger, 2006).

Some of these responses seemed to assist them in climate impacts while others proved obsolete in the event of the same scenario (Wisner et al., 2004). Therefore, many of these activities cannot be considered as strategies (because “a strategy” usually involves a clear vision that often generates positive results), rather as responses may or may not envisage a clear future. For example, looking for additional income sources like driving a taxi (a three-wheeler) and buying and selling businesses have become important diversifications to combat the effects of climate impacts while the most popular responses of changing fishing gear and seasonal outmigration have become obsolete for some fishing families. This becomes more challenging when people are unaware of the real cause of the change, as discussed earlier. It is also important for people to be aware of the causes of the change when they are at the point of adaptation which, for this will facilitate long-term sustainable adaptation.

However, as climate change appears to be less important in shaping the dynamics of adaptive responses than political and economic factors, which is also confirmed by Adger et al. (2009), the need for understanding the causes of climate change seems trivial for those perceiving a need to adapt. Therefore, many of the adaptation responses shown in Figure 7.2 cannot be fully attributed to the respondents’ apprehensions or concerns about climate change.

Figure 7.2

Adaptation responses of the participants of five (5) GNDs (%)



Adoption of new technology is partly a result of the availability of subsidised technological facilities. Other responses are also similar to those of any household that would adapt during hardships and that has been doing so over many generations. For example, borrowing money from village money lenders, microfinance institutions or social networks, pawning their jewellery in banks, reducing the number of meals per day, and selling moveable assets were not novel concepts for them at all. Even illegal emigration is

not perceived by many as a solution to climate change impacts. Instead, it is justified by certain families and their neighbours as efforts to seek better living conditions. Outmigration which is common in other countries in a similar situation (e.g., Alam et al., 2016) is also common here, yet not a novel concept as these fishers have been doing it for generations. Migration has been practised for generations and is mainly deemed necessary for maintaining or increasing income during seasonal variations in fish availability and fishing conditions but not recognised as necessary for responding to climate change impacts. Although initially we assumed that the situation would trigger the habit, no difference to the trend could be observed in that regard. On the contrary, for some families it has become an obsolete adaptation response because either the areas to which they used to migrate suffer from similar consequences or there is a threat of conflict between resident and migrant fishers.

Nonetheless, the results revealed three main trends that could be associated with climate-related adaptation responses: exit fishery and start self-employment or join a private company as employees; educate their children to have an occupation outside fishery; send the women of the family abroad to work as housemaids, encompassing the trend that the role of females in the household has been transferring from housewife to bread winner. These three strategies have been mentioned by many as recent trends. Rare during their fathers' and grandfathers' time, these trends very likely emerged as adaptation responses to climate impacts. Even so, as household No. 92 of *Egodawatta* (the president of *Egodawatta* Fisheries Society) highlighted that education is not an option for everyone:

Like everybody (in Sri Lanka) we believe that good education is a solution to many problems. But you know, not everyone is a don. There are children who are not good at education. So, for them this is a good living. The only thing is this sector needs to be looked after by the government. Obviously, not the way they are doing it now, exploiting us with all these bribes and injustice acts. (Household No. 92 of *Egodawatta*)

Additionally, the perception on warning signals and evacuation during a disaster was also investigated to understand how well people cognitively prepare to respond to a sudden disaster, particularly as they do not often come across such circumstances yet live in a geographically vulnerable setting. This inquiry conferred the most striking findings.

The majority clearly conveyed the message that they would neither follow warning signals nor evacuate during a disaster, irrespective of the damage such an event could cause. There were three reasons given for this. The first was that after the experience of the 2004 tsunami, they were asked three times to evacuate the area due to likelihood of occurrence of another tsunami which never became a reality. Instead, they had to congregate in a community hall depending on others for clothes and food for three days. The second was that they firmly believe if a disaster damages or destroys their belongings and dwellings, it is better to die along with them rather than having a distressful and sorrowful life afterwards. Thirdly, they believe if it is God's decision, they will respect it as they have no power to supersede his actions. Apart from these main reasons, a few respondents also stated fear of theft as a reason for not leaving the premises during an evacuation.

The evacuation procedures exhibited mainly during the 2004 tsunami also seem to be governed by the gender of the people. Men in these communities opt to evacuate last or even not to evacuate at all while sending out women, elderly, and children first. This also reflects the norms of masculinity where men prefer to rescue rather than to be rescued. Accordingly, as argued by Artur and Hilhorst (2012), people strategize who goes first, last, and stays behind during evacuation procedures. For the most part, this clearly demonstrates a need for policy intervention that could transform these perceptions and norms into healthier and more useful behaviours to minimise the risks of hazards to everyone equally during a natural disaster.

In addition to this striking finding, the participants did not show any strong cultural ties to their land where their households were located. This contradicts the findings by Hidalgo and Hernandez (2001), Kuruppu and Liverman (2011), Lewicka (2010), and Twigger-Ross and Uzell (1996). They expressed their willingness to relocate to a secure place, closer to the sea where their livelihoods are. Therefore, this disposition is mostly related to their concern over the security of their families rather than with livelihood diversification. However, there were incidents in coastal communities in the southern part of the country after the 2004 tsunami when people who were given houses and land elsewhere came back again to where they used to live and established temporary dwellings, while the houses they were given were rented out or used as second homes. Therefore, it is hard to decide whether these statements on being ready to relocate are a sign of little connection with the land where they live or of the desire to acquire land and a house in a different

place, particularly in a culture where landownership is a source of pride. Although they exhibit flexibility to relocate, they firmly stipulate that the community as a whole must be relocated, not just individuals. This reaffirms the strong affinity that households have with the people around them. They believe that it is their community who respects their identities and accepts them for who they are, thus they want to spend their entire lives within the very community setting in which all their past generations have lived.

The other most important revelation in the study is that, unlike studies in the farming sector which often promote improved technology as a solution to climate crisis, the majority of fishers of old school plead the opposite. In other words, improved technologies such as high-power motorised boats and satellite technology which have never been monitored and controlled yet have been subsidised and promoted by both formal and informal institutions, are now believed to be threats to fishery, chiefly owing to overexploitation. The fishers of the old school also believe that this is a reason that the young generation is becoming distant from nature, the very system that nurtures them.

Traditional customs do not only relate to the fishing skills and knowledge but to the bonds they have with the sea and the lagoon. These associations earn them the knowledge to interpret the behaviour of the natural systems that support their livelihoods. For example, fishers of the old generation could predict occurrence of fish species very accurately just by looking at the colour of the seawater and the sea birds flying above (Gunawardena et al., 2016). This intimate relationship with the ocean and its surroundings allows the fishers to identify changes right after they occur in the system, thus ensuring prompt reaction. However, this centuries old, accumulated knowledge of resource users which is often referred as anecdotal (Hamilton & Walter, 1999), is challenged by climate change impacts owing to high uncertainty and disruption of lifelong patterns in weather. Adger et al. (2013) state how traditional knowledge and cultural identity of Arctic fishers, especially their traditional housing, are subdued by the impacts of climate change.

Taken together, the scholarly work that attempts to establish a relationship between perception and adaptation usually reveals both positive and negative correlations. For example, the studies of Arbuckle et al. (2015), Finucane (2009), and Menapace et al., (2015) reveal how well psychological factors, in particular perception, affect the whole process of climate change adaptation with respect to the process of decision-making as

well as actions. Hogan et al. (2011) claim the opposite, stating that the role of perception is trivial in adaptation action. The findings of this particular research however stand between those two arguments. Accordingly, it suggests that initial perception and appraisal are fundamental to long-term adaptation to climate change impacts, particularly owing to their role in the decision-making process, although they do not guarantee an ultimately appropriate action. In other words, despite the fact that the translation of perception into behaviour is determined by various and numerous socioeconomic, political, and environmental factors, it does not lessen its significance as a starting point in the process of decision-making in a climate crisis. These findings are in accordance with the stages of change model of Prochaska and DiClemente (1983) which demonstrates successive steps of change in human behaviour, where the first two steps (pre-contemplation and contemplation) signify the role of perception as the form of awareness that is applicable to this study.

Adaptation action without initial risk perception can supposedly be achieved through huge adaptation incentives offered by governmental organisations. These are highly unlikely to happen in the context of this study. Even if they happen, sustainability is a problem as the action is not founded on individual perception but by external incentives, thus when the incentives end the action is no longer guaranteed. However, the idea of these subsidies and incentives seems to be highly appealing to the respondents, yet their comments imply how unsustainable such incentives would be. According to household No. 154 of *South Weralabada*:

If the Government promises to look after us, we will do what they ask us to do. Otherwise, why should we listen to them? If we earn only, our families can have food. At least they should give some rations for the people who do not have income these days due to declined fish stock. There are times that fish harvest is low. These times we expect the government to look after us. What else we could do?

(Household No. 154 of *South Weralabada*)

The study also reveals people's political views can have a great influence on their perception, as also described by Leviston and Walker (2011), and in turn on any adaptation actions. Within the context of this study, it is evident that if a person is a supporter of the current government, they seem to perceive less risk on the ground of strong support for current political leaders who may not perceive climate change as a

threat. At times villagers go against their own people by taking the side of politicians and corrupt officers. Despite the unfathomable reasons behind this trust, they vote for politicians who are out of touch with their needs. Some of them worship these politicians. This devotion largely influences their actions despite the number of broken promises. The previously discussed case of the fight to construct a playground in a mangrove forest reserve provides a simple example of that. Based on the arguments of Kahan et al. (2012) and Niles et al. (2013), this research also proposes the significance of studying the political ideologies of individuals in greater depth owing to their ability to shape beliefs and perceptions associated with scenarios of climate change. The answer of a respondent from Household No. 156, when he was asked why they cannot unite and complain to the authorities about behaviour of corrupt officers clearly exhibits the nature of such political affiliation existing in their societies despite the strong network they possess as a community:

See that is the problem. When we claim one thing, the others who are supporters of those culprits say something against it. So, it is hard. Even though, many of us are now disappointed with all political parties, there are people who still go after them. Obviously, they are [more] powerful than us, because they got the support of those bad politicians. Even though this is done by a few people we can't go against them. As I said, despite the [small] number, they are powerful than us. (Household No. 156 of *South Weralabada*)

It is also revealed that all type of government assistance they receive so far solely focusses on promoting fishing without diversification or natural resource development, except for a few mangrove cultivation programs conducted by the local government. Likewise, subsidised kerosene for boat engines, delivering of fishing nets on subsidy rates, subsidised satellite facilities to locate fish, and financial assistance given to repair damaged boat engines, are all centred on promoting the activity of fishing despite the fishers' current circumstances. Yet, many scholars have stressed that livelihood diversification is an essential component, especially in the event where the major livelihood of the people is largely threatened by climate change impacts (e.g., Davies, 1996; Krishnamurthy et al., 2011; Little et al., 2001). Despite the argument of Niles et al. (2013) that suggests the use of a government carrot is better than a stick to instigate climate-related actions together with policy strategies, these acts of government in the

study area are not associated with any formal policies. They seem to be driven solely by a political agenda that counts on their votes rather than on solid scientific findings that could assist sustainable long term adaptation measures to climate impacts.

The limited knowledge or understanding of those people of the ways they could change without always depending on fishing or its associated livelihoods, is also accountable for hindering the adaptation. These findings are largely compatible with those of Kuruppu and Liverman (2011) and Hasan and Nursey-Bray (2018). If we apply this behaviour to the model of Stages of Change Model (SCM), it is highly likely the majority belongs to the contemplation stage as they are aware of the problem (may not be by its scholarly terms but by firsthand experience) but are uncertain of the response.

The results clearly demonstrate the reluctance of fishers to diversify their livelihoods to sources where fishing is not involved. Almost all fishers declared that their families had been doing fishing for generations and that they did not have other skills to utilise when changes impacted their livelihoods. They therefore preferred to stay with the status quo. On the other hand, these communities have unique characteristics presumably originating as a result of their main livelihood, fishing.

In these coastal communities, fishing is not just a source of income. The relationship with the sea, the activity of fishing and lifestyle that revolves around fishing are unique traits of the culture. Their whole life, encompassing social values, cultural values, and political views, is blended and intertwined together around fishing. The strong affinity with this culture was clearly evident during the analysis, where almost all male respondents who used to work abroad and also families with a male member abroad emphasised how unsatisfied they are to work away from their residence. This was mainly owing to the absence of the life within social networks they used to adore and relish while they were at home despite the financial stability such jobs brought to their families. Many cases were found where fishers gave up occupations abroad just to be with their family and friends despite the guaranteed and satisfactory income they used to earn. According to Household No. 577 of *Weralabada*:

I tried, but I can't do a job outside of this area. This is where I belong. I was born here, and I lived here. So, I want to live and die here. Those lives in closed doors without friends are unbearable and miserable. (Household No. 9 of *Weralabada*)

This is, however, in contrast to what women think, particularly those who used to work abroad as housemaids. Some of them are even ready to go again if they are given another chance. Nonetheless, with the male being the head of the household and main income provider in many instances, this female perspective does not seem to have the power to change the social structure within which household decisions are made despite recent trends. Somewhat similar to these findings is the discussion by Li et al. (2013) who stated that division of labour and decision-making power are usually reflected in climate-related perceptions. Despite the contradictory nature in their responses to going away as an option to financial hardships brought by impacts, both males and females seem to respect each other's decision. For instance, a member of Household No. 137 expresses her opinion about her husband's return after giving up his job as a fisher in Dubai:

You know, they are not like us. We will go anywhere if it assists our family to be in a good position. But they can't. They have been doing this job here for so long with all the others, it is not easy for them to go away and live without their friends. For them, friends are also their family. (Household No. 137 of *North Weralabada*)

Like her, many women seem to support their husbands. At times I witnessed the opposite where the male head of the household let his wife talk, stating that he knew only fishing, but the housewife knew every other thing better than him. Additionally, many residents specifically mentioned that domestic violence which was prominent in the old days was not occurring currently. In all, this shows that a process of adaptation has to be implemented carefully, prioritising group social values and in some cases acknowledging who people are now without judging their past.

Overall, this study supports the claim by Finucane (2009, p. 4) that risk is "socially constructed", thus the corresponding adaptation actions will be socially constructed. Despite the scientific descriptions that largely explain the aftermath of climate change impacts, respondents' perceptions in that regard seem fundamentally governed by their faith, close affinity with fishing and associated cultural practices, the information they get from their respected and trusted sources of social networks, and their political views. In fact, none of the participants denigrate fishing as a livelihood. Instead, they perceive it as one of the greatest jobs on Earth mainly owing to the freedom. Also, they state that if they had been given assistance during adversities, they would have never thought of giving up

fishing as their livelihood. This indicates their strong affiliation towards fishing, and thus the likelihood of their having immense cognitive barriers to exiting from it.

Therefore, the interventions either to reduce vulnerability or to improve adaptation purely guided by scientific descriptions are likely to be challenged by this community. Said otherwise, the programs that tell them that risk is prevailing and that they need to respond to it in certain ways are unlikely to be convincing to them (Patt & Schroter, 2008). Tanner and Allouche (2011) stress the significance of narratives in determining the circumstances of policies and their future. As they explain: “narratives are storylines that help identify competing ways of viewing a particular policy problem. Broad narratives around climate change include one which suggests that climate change is a grave threat to humankind” (Tanner & Alouchi, 2011, p. 10). This advocates the power of narratives to determine behaviour of communities towards a threat, including towards associated policies either to neglect or to respond to it. Consequently, this will impact the ways in which the community supports an associated policy or disregards it (Tschakert, 2007). Therefore, simply providing the community with information on causes and effects of climate change alone will not be able to address the perceptions which grow out of lifetime experience (Patt & Schroter, 2008) and narratives as such. However, the alternative is giving people the opportunity to discourse and realise such circumstances through a combination of science, policy, and practice (Howden et al., 2007) where capitals, resource entitlements and institutions have critical roles to perform (Adger, 1999; Leach et al., 1997).

7.5 Capitals and Alternatives in Adaptation

Following recent calls to consider vulnerability as a starting point, this section employs the concept of livelihood capitals within the purview of a political economy approach to understand adaptation measures in the study area together with associated barriers. The fluctuation of capitals in the process of adaptation is portrayed in Table 7.2. Chambers and Conway (1992) state: “a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living” (p. 6). This is the very definition the study adapts. Several other scholars argue that the manner in which entitlements and capitals are operative in a system largely determines its vulnerability and security, thus its adaptation mechanisms (Adger, 1999; Adger & Kelly, 1999; Chambers & Conway, 1992). In particular, the social order, livelihoods, and stability of resource–

dependent communities are often determined by their resource production and localised economies (Adger, 1997).

Table 7.2

Fluctuations in capitals in relation to recent distresses

Main Capital	Fluctuations beyond normal
Natural	Decline in fish stock
	Anomalies in fishing seasons
	Anomalies in wind directions
	Unpredictable weather
	Exploitation through destructive fishing methods
Human	Intensification of time and energy
	Short term exit from the main livelihood of fishing
	Reduction in both quantity and quality of the meals
	Feeling of being lost and discarded
	Rupture of family unity over housewives leaving homes mainly over jobs abroad
	Increase in alcoholism
	Conflict among peers' overfishing methods
	Tendency to commit unlawful acts
Financial	Reduction in income
	Saving less or not at all
	Utilization of current savings
	Increased debts
	Selling or pawning movable assets (jewellery, TV, audio set, etc.) at low prices
	Tendency to invest in risky endeavours such as in illegal agencies that send domestic workers to Middle East countries
Physical	Poor maintenance of assets
	Encroachment of the bank of the lagoon and beach
Socio – political	Protesting to demand subsidies (e.g., Fuel)
	Increase in conflict and theft
	Decline in social security
	Emerging threats to the existence of open access fishery which has been available for generations

Accordingly, the findings of this study clearly demonstrate that deteriorating natural capital has largely impacted on the rest of the capitals: human, socio-political, finance, and physical. In this case it is due to the dwindling fish stocks, and associated uncertainties such as anomalies in fishing

seasons and unpredictable nature of the sea. While some continue to hang on to intensifying their fishing operations to cope, a few people exited their lifelong livelihood of fishery for alternative livelihood incomes, mainly owing to a number of empty-handed fishing trips. However, at the time of the research these exist appear to be short-term responses as no-one is ready to sell their fishing gear yet. This is not surprising in a lifelong fishing community such as this. Their faith in God is also enormous, thus they have constant hope for the future. Letting go of assets that they have been using for so long is not as simple as selling a business for them but is accompanied by a lot of mixed feelings encompassing the feeling of losing their identities and pride. This was evident in the responses to the question, “now that you stopped fishing what is next? Are you planning to sell your boat and invest it on any other business?”. The interviewee of Household No. 70 of *Weralabada* answered:

What do you mean what is next? Oh Jesus, I am not going to sell my boat. After all, I am a fisher. We will find a way to live. My elder daughter who is abroad will look after us anyway. But I don't want to be a burden to them. The Saint Mary will find us a way. (Household No. 70 of *Weralabada*)

Similarly, a resident of Household No. 85 of *Egodawatta* stated:

You know, I never thought that I would have to stop fishing one day. Who would have thought such a thing anyway? If I knew that when I was a boy I might have ended up as a carpenter or mason. But now I don't possess any other skill other than fishing. We will find a way. Selling is not an option. I will rather let them [go] rotten. (Household No. 85 of *Egodawatta*)

These choices are conditioned by the extent of and access to a capital base while these practices or coping mechanisms are largely impacted by capital fluctuations. For example, the fishers who exit fishery, whether for short-term or long-term periods, decided to secure their human, financial, physical, and socio-political capitals while intensification forces other fishers to put more human, physical, and financial capitals in place. So, they spend more time at sea, going to remote and deeper locations or increase their capacities in terms of number, size, and efficiency of fishing gear. However, these adaptations potentially create negative consequences, mainly when overexploitation is a concern (Daw et al., 2009, p. 138). Nonetheless, it is highly acknowledged that sustainable intensification of fishing is no longer a promising adaptation strategy for the fisheries sector (Daw et al.,

2009) where some scholars argue that almost all fishing grounds in the world may have passed their thresholds in relation to fish catch (e.g., Ludwig, 1993; Pauly et al., 1998).

Alarming, the situation in the area is further exacerbated by unsustainable fishing practices and unethical behaviours among the community which result in negative impacts on the socio-political capital. It has evidently damaged social cohesion to the extent that conflicts have broken out between resource users who have been peacefully sharing the open access common resource for generations. Harmony among fishers is crucial in controlling entry into open access fisheries in Sri Lanka (Athulathmudali, et al., 2011). Even though these conflicts only recently commenced, poor law enforcement and institutional failures to address these issues fairly leave these coastal communities in chaotic situations. On some occasions the Church has attempted to intervene. As one of the participants comments:

We can't neglect what our Rev. Father (Parish Priest) asked for, even if we don't agree. We have to do something about these fishers who destroy the sea. After complaining nothing has happened. So, we thought that was the last resort. Who likes to fight with friends? We all are fishers. So, we too don't want to fight with them. But what options do we have, if the authorities turn their blind eye to these illegal acts that destroy our harvest... (Household No. 105 of *Kurusapaduwa*)

This unfairness is often associated with political affiliations and bribery which treat similar types of unethical and unlawful acts by households differently, whether their livelihoods are from fishing or any other alternative. For example, there were two households with incomes just above the poverty level that built small food outlets on the bank of the lagoon. Apparently, this maladaptation took place as a solution to the loss of income from fishing. As well, they had the bargaining power to receive the support of politicians to accomplish that unlawful act. When a member of one of those two households was asked what made them build that food outlet structure on the bank of the lagoon despite it being prohibited by the law, she says:

If everyone else can do, why can't we? And we do not do any harm to anybody. We just try to survive. I have a big family to look after. The people who say no to these don't come and feed us. On the other hand, I sell food, mainly breakfast for fishers here. So, it is a service. (Household No. 137 of *North Weralabada*)

When she was further asked about the occasional flooding that could damage her structure and the way encroachments could harm the lagoon itself and the surrounding dwellings including hers, the response was:

It is a very simple structure. The costly part was to fill it. In fact, the elevation here is little higher than that of other places. So, flood is not a big problem to us. And I do not pollute the lagoon. I don't throw garbage to it. So, I don't harm it. (Household No. of 137 of *North Weralabada*)

In contrast, a fisher in the same study area who uses livestock as a source of additional income was asked to demolish the shelter he constructed on the buffer zone for his pig, despite his low-income level. He did not possess political power as in the case discussed above, thus failed to secure the structure. Yet, he is aware of the above incidents where the two households mentioned earlier were allowed to retain their illegal developments while he was not allowed to do so. He shows his frustration in his words:

You know, madam, we are poor, and we don't have political power. So that's how we get treated. (Household No. of 126 of *Kurusapaduwa*)

These incidents exemplify how the socio-political capital of households governs their responses to distresses in livelihoods and relationships among households. Despite the strong connection they have with the natural resources around them, these incidents reveal their poor environmental literacy. They often know how nature around them behaves but have little or no understanding as to what governs those behaviours. For example, those households know when the lagoon is rough and when it floods but do not know that siltation and encroachment can cause floods.

The lagoon fishers provide another example of how deterioration of a natural resource, the lagoon, due to pollution and/or climate change affects the socio-political capital of the households in terms of culture. While the identity and dignity of traditional lagoon fishers who have been practising conventional methods of fishing ever since its inception are now diminished, their place in society is taken by modern fishers who own motorised boats. Many modern fishers demonstrate that it is a matter of pride for them to own a motorised boat, especially one with a high horsepower engine. Some of the interviews with modern fishers reveal their stronger attachment to the motorised boats they own than to their dwellings. It also senses the meaning of their trust in technological or material

advancement over the traditional knowledge that their ancestors relied upon for centuries which is now challenged by the uncertainties associated with current climate change impacts.

Referring to the works of Swidler (1986), Hays (1994), and Adger (2013) culture can be defined as “the symbols that express meaning, including beliefs, rituals, art and stories that create collective outlooks and behaviours, and from which strategies to respond to problems are devised and implemented” (Adger et al., 2013, p. 1). Culture is thus implanted in all forms of human experience, from production to consumption to lifestyles to social organisations. Cultural aspects of communities play a key role in framing climate change as a phenomenon of concern to the community and thereby defining their adaptation mechanisms. Therefore, understanding culture means understanding human responses together with their causal factors (Adger et al., 2013). Clarke et al. (2013) identify a cultural base as one of the significant conceptual underpinnings in defining coastal governance, hence its vital role in addressing climate change impacts.

It was revealed during the face-to-face interviews and FGDs that the participants value and respect certain norms during fishing in the sea. Such customs that are not overtly rational apparently play a crucial role in open access resource use. When they were asked why they do that, the majority stated, “it is how it is”. A fisher who arrives first to an area is inevitably granted authority over that area while the following fishers look for alternative spots, making sure to maintain a distance to ensure that other fishers are not disturbed. This resonates with the findings of Quimby (2015) who explains that the fishing operation of Haloban fishers is not purely opportunistic. Neither of these examples of cultural courtesies are governed by defined rules, but by cultural values.

However, the harmony existing among fishers for centuries which was once threatened in 1950s in Sri Lanka after new technologies were introduced seems to be threatened again by climate change impacts owing to the stresses that they inflict on their livelihoods. A few troubling incidents, such as violation of norms that fishers have been practising for generations while fishing and use of destructive fishing methods reported in the recent past, mainly performed by intruders from neighbouring villages, provide good examples of this. Overall, this signifies two major concerns: the first, the effect of climate change on centuries old fishing cultures; secondly, the need for addressing cultural norms of fishers in managing open access resources in responding to climate change impacts. Quimby

(2015) further suggests the usefulness of participant observation at sea as a technique to understand these unarticulated culturally guided courtesies that arise in context.

Additionally, the homogeneity of residents mainly in terms of race, caste, religion, and livelihoods (fishing) apparently constructs strong and unique cultural identity for these five villages as a whole. This is further strengthened by their geographical isolation (between the sea and the lagoon) and social networks where many residents are surrounded by their relatives. Signifiers of people's shared cultural values are: strong faith in God; the numbers of religious statues established along the roads and in front of the houses; vested authority in the Parish priest that is sometimes more powerful than that of the Police; celebration of church ceremonies; behaviour during conflicts within households and among neighbours; and political views of the residents. As a researcher who has had the opportunity to interview people from all walks of life including rural, urban, educated, and non-educated in a professional career, I personally experienced the difference as to how they respond to an outsider who is interested in learning about their ways of conducting their lives. In that, they are very cooperative, open, straightforward, if the time permits, and do not hesitate to express their anger about certain issues that threaten their livelihoods and wellbeing, encompassing the issue of the corrupted practices of the authorities and the restrictions they place on restructuring their dwellings.

Many of the dwellings situated in these coastal belts are illegal yet have remained there for decades. Thus, the practicality of a go by-the-book principle is highly challenged in these communities where one action of authorities can be questioned against another. For example, a house which is made of bricks and tiles built along the shoreline ten years ago was illegal in the first place, thus an additional livestock structure was obviously prohibited by the law. Even choosing livestock, in this particular case, raising a pig in a compact residential area, does not comply with the health measures that are in place. However, as the owners argued, how can an authority stand against these measures when they have not established a proper housing scheme for the coastal community? They also question whether the authorities are going to stop every single activity, particularly alternative income generating activities such as raising chickens, pigs, and ducks conducted by many households who only try to make ends meet. The poorly managed garbage disposal mechanism that leads to widespread littering in the beach area while

some debris are left to rot outside of the houses, was also questioned by many who argued that it raises more hygiene issues than their livestock businesses.

The participants further stated that the authorities should close the fish market¹⁰ first before they come and investigate residents as all fish parts and spoiled fish from the market are usually thrown into the lagoon. Evidently, the hygienic conditions of most coastal and municipal fishing markets are extremely poor and require improvements in basic hygiene facilities, water, and ice (Banks et al., 2007). However, in agreement with Adger (1999), who claims that resource entitlements are subjective to the location, this debate only exists in compact residential areas whereas in less populated areas acts of raising livestock are never a question. For instance, a widower who lives near the cemetery and the corner of *Kurusapaduwa* started raising pigs, chickens, and aquatic fish five years ago, and has never had a problem with either the authorities or residents due to the isolation of the location. This provides a basic example of how spatial variations affect the entitlements and capitals of the people.

Time dimension on the other hand determines access to resources simply because rights and responsibilities are subjective to temporal measures, thus they could change over time (Adger, 1999). For example, the head of Household No. 30 of *Weralabada* invested in prawn farming at the time when it was booming, in addition to his main income of fishing. Even though the initial investments gave him a good return, overall, it ended up as an unfortunate loss that cost him a very large portion of his savings. This loss of financial capital in turn increases his livelihood vulnerability according to Ellis (1998) who asserts that diversification of income can generate two opposing outcomes—either increase or decrease vulnerability of households depending on traits of the diversification and its outcome. This diversification was however motivated at that time merely by profit maximisation but not as an adaptation to stresses even though in the early stages it assisted to minimise livelihood vulnerabilities of the household. At the time of the interview, he had not been to the sea for a week because of poor fishing harvest and had no other plans for what he should do in the future other than hope that everything would be alright, thus adaptation action was not in place. In fact, he was planning to use the rest of his savings until things returned to normal. This exemplifies the fact that sometimes the

¹⁰The Urban Council of Chilaw owns the fish market and usually leases it out to a chosen person after calling for tenders.

well-off fishers who have the capacity to invest in another costly business such as prawn farming can be the last to take actions or to adapt because they have considerable savings that allow them to survive a little longer than the poor who do not have savings.

Conversely, there were a few other households who were above the poverty level yet adapted to the current distresses where women were in the process of applying for housemaid jobs abroad. Despite the wealth, there were also some poor families who followed the same alternative income source with the assistance of money borrowed from village money lenders at a very high interest rate. Apparently, such informal credit mechanisms are a common resource that play a crucial role in the local economy of fishing communities in the events of distresses to their livelihoods (Adger, 1999; Arunatilake et al., 2008; Dow, 1999). Another aspect of this urgent requirement of going abroad as housemaids is exploitation by illegal foreign employment agencies who promise women a job that does not exist and steal their money. This puts these women in desperate situations. The worst happens when they go abroad and find out they are deceived, as coming back to the country involves an expensive and relentless process for them. However, some of the fishers who could afford course fees or who claimed sufficient financial capital decided to invest in courses from different disciplines to secure more stable incomes for their sons, thus sent them to learn mechanics (repairing vehicles) or computer science.

Poverty, which in this study is reflected by income, mostly determines the degree of access to capitals and people's vulnerabilities (Adger, 1999). Thus, it affects adaptation, more precisely, the capacity to adapt. Yet, individuals could look beyond and find alternative livelihoods or income sources that stabilised their own households as in the cases discussed above who used the mechanism of credit to fund the opportunity for foreign employment. Despite the economic bonus associated with this alternative income source of females going abroad as housemaids, the social and emotional ramifications of this solution are considerable. This has even drawn the attention of policy makers owing to its substantial socio-political impacts on society and the country as a whole, since it constitutes the second largest form of foreign income in Sri Lanka (Ukwatta, 2010). Two main impacts noted during the research, however, were husbands' addiction to alcohol and drugs and behavioural changes in children which are often negative. Mothers who attempt to compensate for their absence by giving children material benefits seem to

impair them to the extent that the children no longer attend school willingly or regularly. Some of the interviews clearly demonstrate the rupture of family unity that is brought by female outmigration when fishing no longer serves as the main income for the family. A father of two children who no longer works as a fisher and whose wife works as a housemaid abroad clearly articulates this situation in the conversation:

Most of the time I am not home, neither [is] my son. My elder daughter who is married and lives close by often provides us food. My wife sends her some money. So, I often go there to eat. My son is so spoiled, now that he has a gang, many in that gang are older than him. Even he stopped going to school. I told him several times, but he didn't listen to me. When I told my wife, she wanted to come back, but then who is going to give us money? I think she will stay there a little longer at least until we finish our house construction. (Household No. 58 of *Weralabada*)

Another woman who used to work as a housemaid also shared her views in dejection:

I was in Dubai for nine years. They wasted all the money I earned. My husband, I don't like even to call him my husband, he is an alcoholic. When he is drunk, I don't stay home, I go elsewhere and hide until he falls asleep. Otherwise, he would hit me and ask for more money. (Household No. 34 of *Weralabada*)

When I asked her whether she saved some money for herself, she replied:

How can I? When they ask for money to have food, how can I hide money? We are women, we are not like those selfish men. I can't leave them to die of hunger. (Household No. 34 of *Weralabada*)

However, from a different perspective the outmigration of women signifies change in gender roles in the coastal villages where the roles of women were transformed from carers to bread winners. In addition to migration of women as housemaids, we noted many other incidents where wives of fishers were ready to take over the financial burden of the household in the event that their male head of the household was not in a position to meet the family's basic needs owing to decline in fish harvest. For example, two women joined as labourers in a large-scale dried fish business in the same area while another woman started working as a domestic worker in a nearby wealthy house. Both these cases exemplify women are taking on additional roles. So, it is not much of an exchange of roles,

rather it is men passing the financial burden to women of the household. Although these three examples constitute around 1% of the total participants, many fishermen stated that their wives have been looking for income sources in the event that fishing does not generate any income. However, some of the women in the area have been sharing the financial burden of the household for a long time through enterprises such as selling fish or dried fish in the market and through petty trading. The earlier case therefore signifies a new trend where women who earlier were full time carers now look for alternative income sources.

As discussed earlier, seasonal out-migration of fishers used to be a possibility which has now become obsolete. In this particular study, it was revealed that migrant fishers (participants) have more skills than the resident fishers in those areas. This gap creates tensions between the two parties, thus the fishers from this study tend not to out-migrate during certain fishing seasons. A few others also gave the reason that the lower profit they would gain is not worth all the trouble. Neither participants nor any of their family members have left the area for a non-fishery job in any other area in Sri Lanka. Some of the young men and women from fishing families now work in garment factories and retail clothing shops in the surrounding area. These available options however subject poor families to the likelihood of exploitation, resulting in frustration. When Household No. 158 of *South Weralabada* was asked about her opinion on that she stated:

I don't know. May be if it is Sri Lanka we prefer here, our home. With the boarding fee and transport cost we may not be able to save much if we go somewhere far from this village for a job in Sri Lanka. In fact, those boarding lives are horrible. And we can find garments and shops to work somewhere around here, close by. Even if it is little distant, they provide us the transport. So, if it is not abroad, we prefer not to go elsewhere in Sri Lanka. We would rather find a job that we could travel daily so we could stay home not in a boarding house.

But the only problem with those garments factories is, it is very hard to take a leave. Now that my wedding is coming it is very hard. They even ask us to do overtime, so no time to arrange things for my wedding. My father has to do everything.

(Household No. 158 of *South Weralabada*)

The low-income poverty of some of the households here is related to competition from peers. Many complain that the people do not attempt to be innovative in adaptation, preferring to copy what another person is doing well. For example, initially there were few three-wheelers¹¹ in the area to provide transport for people while giving the drivers an adequate income. Then, when people understood that taxi driving could generate a good income, many people bought three-wheelers to provide the same service to residents of the same area. This led to poor income for all and no longer serves as a substantial main income or even a considerable additional income. Some of the fishers who owned three-wheelers even complained that people preferred the new ones over the old-looking ones, thus they no longer had many taxi hires. Despite these arguments, there are cases where parents used to rely on only one or two trustworthy three-wheel drivers to take their children to school and bring them back. So, people who value quality of the service over appearance of the vehicle still prefer to rely on their old three-wheel (taxi) drivers.

This is also the case with petty trading in these coastal areas. There were a few shops that had to close because of this competition, however many closures are still related to economic failures as debtors do not pay back what they owe. This implies that when it comes to adaptation, innovation is as equally important as diversification, because copying or multiplication of the same type of businesses can sometimes lead to loss of the main income for some of the families due to market failures. However, there are social networks that assist them to overcome some of their difficulties.

Fisheries Cooperative Societies (FCSs) are a common and more formal type of social network that operate in coastal communities. Primarily, these societies provide credit support for their members. Some of these fishery societies however are in the hands of political aggressors, thus have lost their focus. The findings clearly demonstrate that these societies facilitate or act as channels for distributing both “in-kind” and financial subsidies. Thus, their functioning is largely associated with outside governance mechanisms which in turn implies their incapacity to stand up for themselves or said otherwise, voice their concerns about the many issues that influence their livelihoods. Having a similar view, Banks et al. (2007) argue that these societies should be empowered to move beyond this point and have a strong voice in marketing channels and other implementation

¹¹ Three-wheelers are a type of low-cost small taxi popular among people in Sri Lanka for their day-to-day travelling, mostly over shorter distance.

programmes in the fisheries sector, in addition to claiming financial benefits. Participants' dissatisfaction over the governing system in place highlights the need for collective action, leading to empowerment.

In terms of financial inclusion, small-scale fishers in the area have limited or no access to credit schemes in the formal banking system due to absence of collateral and poor repayment capacities. This is a common scenario that prevails throughout the coastal belt (Arunatilake et al., 2008). Though many organisations that provide microfinance services, such as Berendina, Grameen, SEEDS, Sarvodaya, and Lakjaya, made an effort to fill this gap through credit and savings schemes, the success rates of such programmes are still behind the expected levels. Some of the small-scale fishers do not like the lengthy procedures required by such programmes. Thus, there is still a demand for village money lenders who lend money at a very high interest rate but with little or no documentation, within a very short time. The fishers prefer this informal channel to the formal financial organisations in acquiring credit facilities as was noted by Arunatilake et al. (2008). However, this in turn increases their indebtedness. All participants stated that they seek for the help of money lenders in the event that their friends and relatives are unable to assist them financially. In fact, 97.6% of the participants stated that they are indebted to either their friends or relatives.

One other widespread financial practice among this community and in other coastal areas and rural villages is called a "seettu system" (Silva & Yamao, 2007). This system generally prevails among groups and these groups are formed based on trust and loyalty. The person who organises the group benefits from the first money collection, though at times it could be the person who needs it most. This is practised in a variety of ways and even involves larger amounts of money. Primarily, it is more like a group collection but very complex in the way it operates. The number of times and the amount of collection and other norms are mutually agreed upon by the group. However, this is largely a gender biased practice where almost all participants are women. Thus, this system assists or caters as a mechanism to fulfil women's requirements, such as buying kitchen appliances and furniture, even to renovate a small part of the house, the kitchen in particular, or to paint the whole house.

Saving with the formal banking systems is common among traditional fishing communities and this is the case in the study area. Yet, some small-scale fishers who

prefer hiding their money either in a pot or any other secure place at home while some invest excess money either on jewellery or livestock which can be easily converted to cash. Many of the fishers also tend to invest their excess money in fishing gear, and buying, repairing, or painting their boats. Insurance products are not available for fishers unless they are boat owners. The boat owners in the fisheries sector complain about the insurance products available in the market as these tailor-made products do not meet their requirements. Therefore, it is necessary for insurance companies to consider the criticisms of fishers and modify their products to cater for their needs, irrespective of the high risk and uncertainties faced by fishers (Arunatilake et al., 2008) and consider the attitude of fishers towards such insurance schemes.

In all, the findings exemplify the behaviour and fluctuations of the livelihood capital base of all five GNDs resulting from their responses to stresses that befall their livelihoods. In terms of climate change impacts, their livelihood capital pentagon has shrunk, owing to dwindling fish stock and associated seasonal anomalies. This in one way demonstrates the power of natural capital in resource-dependent coastal communities as this governs the rest of the capitals. It also indicates the need for state intervention, be it through policy or practice, either to restore the affected capitals or to deliver the most suitable alternatives to these communities whose lives have revolved around fishing for generations.

Even though the state has put some subsidiary schemes in place, the majority of interviewees complained that they were excluded from those programmes owing to their inability to pay bribes. The participants found it difficult to contest corrupt practices in their deprived situation where their major livelihood income was hit heavily by anomalies in the sea and the weather. Despite the dire need for outside assistance, almost all fishers were unclear about the procedures and eligibility criteria for the subsidies distributed through the Fisheries Inspectors (FIs) which casts doubt on the efficacy of the formal interventions in place at present. Subsidies benefit only certain groups. They exclude some fishers who do not own boats and businesses other than fishery, such as petty trading, which are heavily dependent upon fishers' income. Consequently, all participants, except the ones abroad, believe that they need a permanent solution to their livelihood destruction and economic hardship, which is deepened by recent anomalies in the sea and climate. The significance of addressing their adaptive capacities is clear. Fuelling adaptive capacities and creating an environment in which they could utilise those capacities would

expand their asset pentagon of livelihood assets and ultimately assist adaptation actions to reduce their livelihood vulnerabilities (Barnett & Eakin, 2015). The role of institutions as agencies of governance and management that enable adaptation actions is central (Brooks & Adger, 2004; Smit & Pilifosova, 2001).

7.6 Climate Change, Institutions, and Policies

Adger (1999) characterises institutions in a wider perspective as the agents or structures of political power and legitimacy, the ones that define standard operating procedures and as the organizations that constitute pre-determined social obligations and global perspectives. The adaptation process which is dynamic in nature is often facilitated or constrained by pull and push factors of the institutional environment where it takes place (Preston & Stafford-Smith, 2009). Therefore, the act of adaptation can be witnessed through the changes in institutions (Adger, 1999).

However, the IPCC (2014) realises that the understanding of institutional involvement in coastal adaptation is limited, particularly in developing island states where the governance structures are weak (Yamane, 2009). To address this gap Hewawasam and Matsui (2019) conducted a study that investigated the evolution of climate change policies in Sri Lanka, in which they found the state had issued twelve crucial documents in relation to climate change during the period of 1992 to 2017. In their view, the major mileposts in climate change policy in Sri Lanka are the formation of Climate Change Secretariat (CCS) in 2008; the development of National Climate Change Policy (NCCP) in 2012 and the institutional development then led by NCCP.

However, addressing climate change issues in Sri Lanka dates back to 1991 with the formation of the first National Environment Action Plan (NEAP) in parallel to the United Nations Framework Convention on Climate Change (UNFCCC), a convention that Sri Lanka ratified in 1993. Consequently, the implementation of the convention took place under the supervision of the then Ministry of Transport, Environment, and Women's Affairs (MTE&WA) and the United Nations Development Programme (UNDP) of Sri Lanka. In those preliminary stages, the Ministry faced two main challenges in addition to funding constraints: finding expertise in addressing climate-related themes and absence of mechanism in place for the coordination of the chosen priorities. These were resolved through the Global Environmental Facility (GEF). The first challenge was, however,

overcome by involving university professionals while the barriers to coordination were dealt with via forming new administrative divisions for the chosen sectors of major importance (Hewawasam & Matsui, 2019). Likewise, the first national communication report to UNFCCC was an amalgamation of the findings of ten major sectors reinforced by particular personnel. They are: energy in relation to fossil fuel; energy in relation to alternatives to fossil fuel; transport; industry and/or industrial and urban waste; agriculture; forestry; water resources; coastal zones, ports, fisheries and tourism; human health; and human settlements and public utilities (MENR, 2011a, 2011b, 2011c).

Subsequently, the second assessment report to UNFCCC was funded again by GEF in 2000, mainly to improve the institutional and individual capacity to conduct such assessments which were identified as gaps in the previous report. These funds were assigned to perform climate change related research that belongs to any of four main themes: vulnerability; adaptation; mitigation; and GHG emissions (Hewawasam & Matsui, 2019). In mid-2003, the Ministry formed its Environmental Economics and Global Affairs Division as required by the Clean Development Mechanism of the Kyoto Protocol (CCS, 2012). The same year, it published the National Environment Policy (NEP) which stresses the significance of flexibility in management mechanisms to address climate change (MENR, 2003).

After two years of its formation, in 2005, the Division was funded for a third time by GEF to carry out National Capacity Needs Self-Assessment (NCSA) for the Global Environmental Management Project with the intention to implement three prime conventions to the Rio Declaration: UNFCCC, the Convention on Biological Diversity (CBD) and the UN Convention to Combat Desertification (UNCCD). A special project management unit (PMU) was established within the Division to mobilise those funds. It eventually formulated recommendations at systemic, institutional, and individual levels with the idea of forming a secretariat to ensure that the country adheres to those conventions while recognising the criticality of national policies and institutional structure in that regard (Hewawasam & Matsui, 2019).

Consequently, the Climate Change Secretariat (CCS) was established in 2008 with the assistance of the Environment Minister at that time who personally conducted seminars and meetings for stakeholders on environmental awareness. Subsequently, the National Advisory Committee of Climate Change (NACCC) was formed in 2008. It constitutes 31 key

stakeholders encompassing ministries, departments, organisations, authorities, NGOs, and INGOs and was chaired by the Secretary of the Ministry of Environment and Natural Resources (MENR). The prime task of this committee is to coordinate all climate-related activities while providing expertise to the CCS.

Accordingly, the CCS has been allocated specific roles in relation to various aspects of climate change, such as mainstreaming issues of climate change into other state development plans, facilitating and disseminating of climate-related research and its findings, and liaising with the UNFCCC secretariat. However, the most prominent work CCS has undertaken was the development of the National Climate Change Policy (NCCP) of Sri Lanka that largely draws upon two main doctrines. First, it was based on the principles of the Constitution of Sri Lanka which stipulates that “the State shall protect, preserve and improve the environment for the benefit of the community” under chapter VI of Article 27 (GOSL, 2020, p. 19) and secondly, the National Environment Policy of 2003 which articulates the importance of sustainable development and precautionary principle in dealing with environmental matters (MENR, 2003). With a long participation process of several institutions encompassing the Institute of Policy Studies of Sri Lanka (IPS), expertise of academics, the general public, and funding support of UN–Habitat, the National Climate Change Policy was legalised in 2012. It required all ministries to abide by its contents, thus to consider climate aspects in their areas of responsibility and decision making (Hewawasam & Matsui, 2019; Ministry of Mahaweli Development & Environment [MMDE], 2012).

The National Climate Policy of Sri Lanka develops its policy statements under six main domains: vulnerability; adaptation; mitigation; sustainable consumption and production; knowledge management; and general statements. Each domain has set its priorities and with regard to adaptation, placing its prime focus on five areas: food production and food security; conservation of water resources and biodiversity; human settlement and land use planning; infrastructure design and development; and coastal resources management. That altogether accounts for twenty–five policy statements. Even so, in relation to climate change on the coast, the policy does not stress coastal livelihoods but potential sea level rise (MMDE, 2012).

Subsequent to the formation of the climate change policy, the National Adaptation Plan (NAP) for Climate Change Impacts was set up in 2013 to account for adaptation programs

and was finalised in 2016 for the period of ten years from 2016–2025 with the assistance of numerous national expert bodies including universities, development authorities, development institutions, ministries, and departments. This largely coincides with the National Adaptation Strategy (NAS) for Climate Change which was formed in 2011 for the period of five years, ending in 2016 (CCS, 2016). Although, NAP was primarily guided by the guidelines of UNFCCC’s Least Developed Countries Expert Group (LEG) for development of national adaptation plans (UNFCCC, 2011), it developed its own process for the Sri Lankan context (UNFCCC, 2011) comprised of three prime steps: preparatory elements; implementation strategies; and reporting, monitoring, and review (CCS, 2016, p. 25).

The CCS (2016) states five main gaps and barriers that hinder successful adaptation in Sri Lanka: information gaps (lack of climate information); technological gaps; policy and governance gaps (the problem of integration); institutional and coordination gaps (the problems associate with adaptations that are undertaken in ad-hoc manner); and resource mobilisation gaps (fiscal and monetary difficulties of the state). It also identified nine key sectors and respective priority areas for each sector. Even though the coastal and marine sector secures its place as one of the key sectors, the plan prioritises four broad areas primarily concerned with sea level rise: coastal zone management; beach stability; coastal biodiversity; and ocean acidification. Coastal livelihoods in particular are neglected (CCS, 2016).

Nonetheless, the CCS (2016) stresses the sustainable use of marine resources while encouraging participation of all in the process of adaptation. In view of that and keeping in line with the recent trend that appreciates participation of communities in development programmes, the CCS (2016) identifies five key stakeholders with whom they will engage throughout its process. They are: the government sector encompassing ministries and all their affiliations; the private sector including cooperates and SMEs; the expertise of academics, researchers; and other knowledge contributors and local community-based organisations. In parallel to the plan, which was legalised in 2017, a major event that took place in relation to climate change in Sri Lanka was the ratification of the Paris Agreement of 2016. The CCS was nominated as the main institution to work on the intended nationally determined contributions (INDCs) of the Agreement. As per the requirement, the CCS commenced formulating a “Readiness Plan for Implementation of INDCs: 2017–

2019” with the goal of adopting INDCs fully by 2020. This was again financed by an outside international agency, the Green Climate Fund (GCF).

This high dependence on outside funds was clearly evident throughout the history of climate related initiatives in Sri Lanka where the Government has been unable to substantially fund a single major project linked to climate change during the last 25 years (A detailed review can be found in Table 1 of Hewawasam & Matsui, 2019, p. 259). This extreme dependency on exterior funds for climate actions in Sri Lanka was finally recognised by the NAP in 2017 and it advocated meeting the dire need for establishing a National Adaptation Fund (NAF) for the country, mainly to assist the National Adaptation Plan. This seems to be a very rational and timely request owing to the threat this reliance on external funds poses on the sustainability of climate actions in Sri Lanka.

Equally, the frequent organisational reforms and complex organisational structures that create instability and duplication of responsibilities apparently hamper the progress of actions in relation to climate change in Sri Lanka. For example, the Ministry of Transport, Environment, and Women’s Affairs (MTE&WA) was first restructured into the Ministry of Forestry and Environment and again in 2002 into the Ministry of Environment and Natural Resources. Yet again, for a third time it was reformed as the Ministry of Mahaweli Development and Environment in 2015¹² and the President at that time took control. In 2020, there are few ministers with environmental related responsibilities: the Minister of Environment; Minister of Wildlife and Forest Conservation; Minister of Irrigation; Minister of Plantation; Minister of Energy; Minister of Agriculture; Minister of Water Supply; and Minister of Industries. The state also appointed a Minister for the Land. Besides these, the Ministry of Fisheries operates as a separate entity under the authority of the Minister of Fisheries.

Similar events took place in the Division of Environmental Economics and Global Affairs which was initially divided into two. The new Division of Climate Change and Global Affairs (CCGA) has been assigned climate science and awareness as its prime concern. However, later when the CCS was formed the climate-related responsibilities of CCGA together with its funds and personnel were taken over by CCS, thus the newly formed division no longer

¹² Mahaweli is the longest river of Sri Lanka around which hydropower projects and various and numerous agricultural projects were established. It is mainly governed by the Mahaweli authority of Sri Lanka.

exists (Hewawasam & Matsui, 2019). Despite the genuine efforts made by some politicians, seemingly many of the structural changes took place as political agendas of the ruling parties whereas some changes took place in order to attract outside funding support. Tanner and Allouchi (2011) refer to situations like this as “a crisis of leadership and vision in the environmental sector” (Tanner & Allouchi, 2011, p. 9).

However, on the positive side, climate change-related endeavours so far have contributed a number of important policies and plans that function as key guidelines in governing climate related scenarios in Sri Lanka. These are: the National Climate Change Policy of 2012; National Climate Change Adaptation Strategy (2011–16); National Action Plan for Haritha Lanka Programme; Sri Lanka Comprehensive Disaster Management Programme 2014–2018 (SLCDMP); National Action Programme for Combating the Land Degradation of Sri Lanka (NAPCLD); Coastal Zone Management Plan (CZMP); National Physical Plan 2011–2030 (NPP); and Sri Lanka Water Development Report 2010 (SLWDP) (CCS, 2016). Additionally, the National Policy and Strategy on Cleaner Production (NP&SCP) of 2012; National Agriculture Research Policy (NARP) for 2012–2016; revised National Housing Policy (NHP) in 2017, and the draft of National Energy Policy and Strategy in 2018 are considered to cover climate aspects.

In contrast, the National Fisheries and Aquaculture Policy of 2018 addresses the climate change aspects imprecisely, while sustainability measures were addressed substantially. In fact, it is primarily driven by the intentions of optimising production and seeking new investments (MFAR, 2018). Likewise, the policy is developed under five main themes: marine fisheries; aquaculture and inland fisheries; consumers and markets; blue economy; and other areas. Each of them is further particularized using a few other titles. The theme of marine fisheries is elaborated under the subtitles of sustainable management of resources; strengthening of governance; increasing fish production; compliance with regional and international agreements; infrastructure facilities; fishing vessels; and safety at sea and occupational safety. Similarly, the main themes of consumers and markets is described in the scope of food security, food safety, and nutrition; elimination or minimising of post-harvest losses; and increasing of exports whereas the main theme of other areas encompass the policies relevant to generation of employment opportunities; environment, climate and natural disasters; gender; improvement of the socio-economic conditions of the fisher communities; subsidies; financing facilities; private sector

participation; human rights; anticorruption; and fisher organisations. The section on the blue economy pays attention mainly to the economic aspects that promote diversification (MFAR, 2018). Implementing these policies including associate reforms is a responsibility of the Ministry of Fisheries & Aquatic Resources (MFAR).

The MFAR is the principal organisation in fishery management in Sri Lanka. Several departments, agencies, authorities, and corporations are controlled by the Ministry under three central themes: implementation; research and training; and services.

Implementation activities are mainly covered by the Department of Fisheries & Aquatic Resources (DFAR) and the Coast Conservation Department (CCD) whereas services are looked after by the Ceylon Fishery Harbour Corporation (CFHC), CeyNor Foundation Ltd and Ceylon Fisheries Corporation (CFC). Research, training, and extension services are carried out by the National Aquatic Resources Research & Development Agency (NARA), and the National Aquaculture Development Authority (NAQDA). The CCD and DFAR are at the top of the hierarchy while services organisations are at the bottom (Banks et al., 2007). The National Institute of Fisheries and Nautical Engineering (NIFNE) which was then supervised under MFAR is now operated under the purview of the Ministry of Skills Development and Vocational Training (MFAR, 2018). Additionally, the Ministry supervises two main entities, the state-owned fish market in Peliyagoda constructed with funds from the ADB, and the National Fisheries Federation which was founded in 2010 to facilitate sustainable development of the fisheries sector. In addition to this, the Marine Environment Protection Authority (MEPA) which is independent of MFAR yet has overlapping responsibilities (MFAR, 2018), is often involved in managing coastal resources.

Looking at the number of ministries and their respective line authorities that work on climate change often causes confusion as to whom certain responsibilities are aligned. In the struggle for authority, the decisions and respective actions often conflict at different scales rather than coordinating in a nested way. Poor coordination among all stakeholders in preparing and implementing coastal plans also creates undesirable outcomes (Banks et al., 2007). Competition over funds rather than integration of approaches is one such outcome, in addition to often resulted suspensions and inefficacies (Chen et al., 2015). As Peter Newell et al. (as cited in Tanner & Allouchi, 2011) note, the allocation of central priorities to a single ministry can overcome this common governance problem of

overlapping responsibilities and duplicated mandates, giving the example of the Ministry of Energy in India.

The findings clearly show the remoteness of many of the services to these communities of five GNDs where people have only heard of the Ministry of Fisheries and Aquatic Resources (MFAR), Coastal Protection Authority (CPA) and the National Aquatic Resources Research and Development Agency (NARA). The NARA occasionally visits fishers of the area to record their catch composition. Alarming, not a single participant was aware of the existence of a coastal zone management plan despite its data gathering in their locality and its special area management component. This exemplifies their distance from the prevailing administrative structures in an era when community-based adaptation is highly regarded in combatting climate change.

7.7 Community Based Adaptation (CBA) and Ecosystembased Adaptation (EbA)

During the time of research, the two main types of CBA that were operative in the area were Coastal Zone Management Plan (CZMP) and stake net (*kattudel*) fisheries (explained below) management of Chilaw lagoon even though CZMP is unknown to all participants by its title. These activities were not initiated as responses to climate change impacts but as solutions to the issues arising in managing open access fishery. The CZMP which is developed, implemented, and monitored by the Coast Conservation Department (CCD) plays a direct role in tackling environmental and climate change related issues which prevail within the coastal communities, including adaptation (Athulathmudali et al., 2011). Although Sri Lanka is one of the very few island nations to have fully implemented CZMP, its popularity among coastal communities is doubtful. The 100-metre rule which was introduced after the tsunami to forbid constructions within 100m of the coastal zone imposes strict restrictions on coastal residents but not on the owners of large hotels. With such biased practices and their primary focus being on natural resource protection, not the associated livelihoods, CZMP was unable to earn the trust of the people and their active participation in general (Rabbani et al., 2010). Rabbani et al. (2010) further claim that the sustainability of coastal livelihoods has never been a priority of Coastal Zone Management Plan (CZMP), thus it is not attractive to coastal communities.

However, it is mandatory to revise CZMP every four years and that gives the space to incorporate new dimensions, challenges, and opportunities to update with attention to

the livelihoods of residents who are dependent on coastal resources. One such important revision is the introduction of Special Area Management (SAM) which intends to promote community participation in managing coastal resources in small geographic areas. Despite its anticipated benefits, we noted that SAM was not a familiar term to any of the individuals interviewed. A study conducted by Panditharatne (2016) concluded that SAM was a failure in its application in the Negambo lagoon (Lowry et al., 1999), mainly owing to the conventional hierarchical power regimes prevailing in countries like Sri Lanka. These are often proven ineffectual in addressing the uncertainties and complexities that are further intensified by climate threats to social ecological systems. In fact, the responsible authorities of SAM thought the project in Negombo was over despite its objective to become a continuous process that facilitates changes and improvement through evolving.

The current governance systems in place do not generally incorporate the accumulated centuries old knowledge of victimised fishing communities into their strategies and administrative capacities. However, there are legal provisions that facilitate inclusion of local knowledge in contemporary fisheries management practices. Many people are unaware of this. A case in point is the Fisheries and Aquatic Resources Act No. 2 of 1996, and the Fisheries Operations Regulations of 1996.

The other example of CBA is the stake Net (“Kattudel”) fishing in Chilaw lagoon. The technique that they use here is stake net fishing and the main harvest is prawns and crabs. The history of “Kattudel” fishing goes back to 1816. Ever since, the rights of the “Kattudel” fishing remain with the descendants of the particular clan that started it, namely, “Mihidukulasooriya clan”. Then there was a conflict when two other clans claimed the same rights. This was eventually resolved through forming an association with the support of the church that guaranteed equal rights to each group in the association (Kurukulasuriya, 1994). In this fishing management practice each group is called “pella”.

Accordingly, each “pella” is allocated different fishing days varied from Sunday to Saturday, all seven days. A fisher needs to fulfil a few requirements in order to become a member of a “pella”. To do so, he: should be a married male descendent from any of the three clans; should be a Christian and his marriage needs to be a church marriage; should be above the age of 18 and below the age of 50; should agree to pay the stipulated membership fee; and should respect government fishing regulations in addition to his commitment to traditional rules and regulations of stake net fishery (Kurukulasooriya,

1994, p. 104). Conflicts among the clans are usually resolved by the association. Members of each group are permitted to conduct fishing activities from 6am to 6pm. The management of “Kattudel” fishing is largely associated with the church that members belong to.

In terms of EbA, the only act found during this research was the mangrove cultivation programme initiated by the Provincial council of Chilaw. The provincial council reimburse the cost of the mangrove planting depending on success of its growth. Some (95 people) of the participants considered it a useless act while some others (101) thought it to be an act that did no harm, though complained that they did not have time to look after the mangroves. Only 10 out of 206 participants put genuine effort into restoring the mangroves along the beach and the lagoon, where one participant had been doing it on a large scale at his own expense. Nonetheless, an NGO called Small Fisheries Federation extensively engaged in restoration of mangroves along the Chilaw lagoon which was largely threatened by the prawn industry. Their activities are funded by Norway and receive minimal government support. However, the findings so far clearly articulate the inability of the resource-dependent coastal community to battle the impacts of climate change alone due to both low adaptive capacity and poor enabling environment. This study therefore adds to the literature that attempts to understand and categorise the scale of adaptation either as a local or global concept, sometimes even as an integration of both.

7.8 Scale of Agency: Global Vs Local

The study revealed that the majority of participants were not aware of the reality of global climate change and its impacts, nor were they familiar with the scientific terminology commonly used to discuss this in the relevant literature and legislation. Therefore, their responses to climate change impacts, or in their terms, response to changes in weather patterns relating to ongoing changes in fishing seasons and the ocean itself, are local. That is, the autonomous adaptations taking place in these communities are context-specific and local. However, the residents’ decisions to find alternative income sources, thus causing fluctuations in livelihood capitals, are steered by local economies which are often dependent on the overall economy of the country and on the global economy. Likewise, the decisions of the state, which is obliged to comply with international treaties and funds in addition to international socio-political and economic

relations, are reflective of the local context where they influence fishers' decisions as to what they choose as alternatives. A few examples in that regard were drawn during the study.

One common example was the subsidising of fishing gear as a result of agreements with outside sources of funds that promote intensification (Atapattu, 1994). Another example is the impact on fishers' livelihoods from fuel price increases, imposed by the government as part of an International Monetary Fund (IMF)–imposed austerity package (WSWS, 2012). The major impact of this was the prohibitive cost of fishing journeys which forced some of the fishers to move onto unpowered boats while others had to sell their catches for a pittance owing to lack of refrigeration facilities. These were direct impacts on people's livelihoods, particularly on their livelihood incomes in addition to the indirect effect of deterioration in the wellbeing of households. This decision of the Government created chaos among the fishing communities, particularly in Chilaw, which ultimately cost two lives of fishers and caused life–threatening injuries to one. All three were shot by the Police during an unarmed protest organised by fishers in the area against the hikes in fuel prices. The murdered fisher's wife left for Saudi Arabia just a month before the incident seeking employment as a housemaid because the income from fishing was not sufficient to cater for the needs of their four-member household that included two children. The fisher who lost his leg due to the gunfire hung himself three months after the incident due to depression over his disability that cost his livelihood of fishing.

This exemplifies the poor economic local context as people do not possess the power to choose between their livelihood capitals. They are not in a position to apply strategies that are most useful in combatting the impacts. Instead, they have to choose from what is available to them, or what they can afford, which does not cater for the strategy for which they plan. Local governments cannot offer assistance because they are largely dependent upon the central government where central government significantly relies upon external funds for both its authority and finances. For example, there were fishers encouraged their sons to acquire different skills in addition to fishing so that they could find employment in different fields, such as information technology and mechanics, if fishery collapsed. However, this is hard for them to achieve as some of them do not have enough financial or socio-political capital either to invest or to be part of a subsidised program

organised by the Government. This implies the essential need of external assistance to strengthen people's livelihood capitals for them to deploy their adaptation strategies.

Ford and King (2015) clearly articulate this scenario through the concept of adaptation readiness which includes the observation that adaptation strategies chosen by households or communities are unlikely to be implemented if the enabling environment and supportive actions are absent in the context. Even if they are implemented, this concept suggests that they will not be sustainable owing to the absence of enabling mechanisms, be they either capacities or governance, or policy and institutional support, or both.

Another example to the scenario of global influence on local adaptations, Household No. 168 of *South Weralabada* raised the issue of encroachment of Indian fishers over Sri Lankan fishing areas, violating the maritime boundary agreements of 1974 and their powerlessness to stop that. A recent study reveals that Indian fishers steal 200,000kg of fish in a day from the Sri Lankan side of the boundary, limiting the livelihood income of Sri Lankan fishers (Klein, 2017). On a wider scale, this restrains the access of fishers to good fish in sufficient quantities. However, neither the Sri Lankan Government nor the Indian Government takes any strong measures to stop these encroachments, thus the battle over fish continues.

The rationale behind this languid behaviour of the Sri Lankan Government demonstrates the country's dependency on India for both imports and exports in addition to cultural and political barriers. Accordingly, some suggest that the ruling parties of both states fear that their remedies to this isolated case of fishers would have a damaging impact on the number of favourable votes that they count on for their victories. India does not want to lose the votes of fishers while Sri Lanka is afraid of losing the Tamil votes which constitute a substantial ballot in its elections (Majumder & Malhotra, 2020). Taken together, this demonstrates how the capital base, specifically the natural capital of this resource-dependent community, is governed by international relations and by their incapacity to respond as an isolated community. It exemplifies the imbalance of power between local fishers and more powerful outside stakeholders that ultimately determines access to resources.

From a different perspective, Grothmann and Patt (2005) emphasise the importance of focusing on longer-term adaptation as what exists in the local context (adaptation by

private actors such as households) cannot qualify as adaptation to climate change impacts as such, since these responses are not long-term and global. Nonetheless, this principle does not underestimate the power of traditional adaptation strategies that lessen vulnerabilities of communities while it lays emphasis on long-term adaptation. Kuruppu and Liverman (2011) clearly demonstrate how conventional knowledge of water management can complement scientific knowledge, given the example of Shiva (1988) who stresses the importance of encompassing local knowledge in policy initiations relevant to water scarcity in India.

Similarly, Adger (2000a), Adger et al. (2003), and Scoones (1996) assert that traditional practices of adaptation can have a positive effect on people's adaptive capacity. They further stress the critical role played by social cohesion in such responses. However, power structures and conventional strategies that assist local adaptive capacity can at times become a hindrance to long-term environmental change and more permanent types of adaptations (Adger, 1999, 2000a; Patt & Gwata, 2002; Ribot et al., 1996). This suggests that adaptation is a continuous process which involves both learning and unlearning. For instance, communities need to unlearn the most famous intensification and outmigration as strategies and learn new trends like finding an occupation outside fishery.

Based on these findings we can conclude that adaptation, in particular long-term sustainable adaptation, is a product of an integration of both local and global aspects in addition to psychological factors. In other words, the adaptation strategies are unique to the context within which livelihood vulnerabilities exist, yet the processes that turn those strategies into actions are dependent upon global factors. People's choice of one adaptation response over another is determined by the social, economic, and political aspects of the country, encompassing its governance and international relationships as well as by their cognitive and objective capacities. The policy implications, future research directions, and conclusion of the study are presented in following sections.

7.9 Policy Implications

Identifying the responses specific to climatic threats is challenging as they are largely shaped by non-climatic factors which communities often prioritize in their lives and which are intertwined with their social and cultural values. Uncertainty about climate change

adds to the complexity of the issue for all stakeholders, yet it signifies the need to take a precautionary approach and to address possible impacts before it is too late.

Overall, the findings assist the claims of many scholars, that science alone cannot battle the global climate change challenge. In fact, the findings of the study demonstrate the need for effective governance procedures that ensure enforcement of the existing laws and encompass policies that acknowledge and value the local attitudes, beliefs, knowledge, and understandings in addition to scientific descriptions. Further, the results firmly suggest the necessity of initiating local discussions on the subject of climate change to educate the coastal communities about the subject that limits their livelihood options and wellbeing. The scientific explorations of experts in the global context have resulted in many useful findings being available but not applied in local contexts. The translation of climate-related words from English to Sinhalese and Tamil so far addresses the informed audience and its discussions, but not the general public like the people of these communities.

Looking at both the physical and psychological aspects of vulnerability through simple pragmatic tools like the Livelihood Vulnerability Index and Perception Index could generate a holistic view of where the problem lies, and at which point the respective authorities could make the interventions. These tools could be a great asset to patrons of any field whose intention is to address the impacts of climate change either through reducing livelihood vulnerability or increasing the adaptive capacity of the people.

The vulnerabilities assessed in the two alternative methods of LVI and LVI-IPCC reveal that one dimension alone does not determine the level of livelihood vulnerabilities of systems, but the combination of all does. For example, the most exposed community is not necessarily the least able to adapt as each of these dimensions is determined by the complex internal and external socioeconomic, political, and biological processes which differ across households and communities. However, comparatively higher values in exposure and sensitivity together with a lower value in adaptive capacity can possibly place a community at the top in terms of vulnerability (e.g., *Kurusapaduwa*). In contrast, the relatively less exposed and less sensitive community with the higher adaptive capacity is less vulnerable (e.g., *Weralabada*). In a situation where the communities are similarly exposed, the combination of higher sensitivity and lower adaptive capacity can create higher vulnerability.

The LVI in particular highlights the major components of: natural disasters, climate variability, warnings and impacts; food; and livelihood assets and practices as the major sectors that need immediate attention of policy makers compared to others, owing to their high contribution to the overall LVI. On other hand, a comparatively low value in the sectors of socio-demographic profile, shelter, health, and socio-political networks implies that fishers in this context are not necessarily the poorest in economic terms but may be among the most vulnerable groups due to their high exposure to current threats to their main livelihood options. This decreases their ability to secure food since these people are extremely dependent on the external market because of their low purchasing power. Somewhat like these implications, Coulthard (2009) recognises that fishers who are overly specialised in one livelihood (fishery) may be less capable of adapting than the poorest. This highlights the requirement for policies that reduce exposure and increase food security while providing options for alternative livelihood opportunities outside fishery. Further inquiry examination of the LVI reveals livelihood diversification and innovation as the most immediate interventions required, where those could fairly address food security as well.

Comparatively, the lowest vulnerability recorded in the water sector surprisingly reveals that this component is not a major problem for these communities, unlike as in many other coastal settings which often endure a drinking water problem owing to saltwater intrusion and poor access to other water resources. This suggests that resources that may have been spent on this sector can be relocated to a more vulnerable sector, for example the food sector. *Egodawatta* provides a good example to other communities, as it reduced its water vulnerability simply through the practice of sharing. For example, residents of *Egodawatta* who possess natural water resources that are not affected by the problem of saltwater intrusion make it available for many other residents, free of charge.

The traits of capital that need special attention can be guided by the results of LVI and PI, because the measures to augment the capital base due to the contemporary threats of climate are highly likely to ensure food security problems. In that regard, the LVI suggests that ensuring legality of dwellings (physical) and access to low-cost financial benefits with simple application procedures can be a great assistance to these communities to expand their overall capital base.

On the other hand, the perception indexes reveal that remarkable cognitive barriers persist in relation to vulnerability and adaptation. The measurement on perceived exposure highlights the low probability of perceiving existing threats while the perceived adaptive capacity reveals the persistence of cognitive barriers to identifying capacities to combat climate change impacts. The PI of adaptation and self-efficacy advocates the need of measures enlighten the people as to what they possess and how those possessions or strengths can be applied during this time of need to overcome the distresses. Perceived sensitivity also reveals a mindset that pulls people towards negativity despite their objective capacities according to the sensitivity measure in LVI, being shown to be better, mainly in the sectors of water and health.

Statements that measure Perception Indexes (PIs) in a specific sector can be a better guideline to policy makers in addressing cognitive barriers. For example, the number of people who have never heard the term climate change and the poor knowledge about its causes, implies that these communities need essential education on climate change, at least to understand the basic forms of the threat that they encounter. Better strategies are only possible if the threats and their causative factors are better understood by policy makers and the communities for which those policies are intended. According to Fankhauser et al. (1999), increasing awareness enables communities to understand the necessity of adaptation, search for viable alternatives, and employ the most effective ones. Similarly, examination of current and past adaptation practices provides insights into the social and cognitive constraints to adaptation. This can be a guide to policy makers in developing policies to overcome them.

Clarke et al. (2013) offer valuable insights in relation to coastal governance, mainly in terms of knowledge uptake, which is applicable to both developing and developed contexts. They discuss five main conceptual underpinnings through which knowledge uptake can be enhanced: epistemological bases; cognitive and psychological bases; cultural bases; Indigenous knowledge bases; and new modes of coastal governance such as collaboration and networks (Clarke et al., 2013, pp. 89–90). Newell and Paterson (2010) propose the allocation of central priorities to a single ministry to overcome the common governance problem of overlapping responsibilities and duplicated mandates to create a more efficient and effective organisational structure. They provide the example of the Ministry of Energy in India (as cited in Tanner & Allouchi, 2011).

7.10 Future Research Direction

Replication of this study in the same locality over time can provide information on how the major dimensions of vulnerability (exposure, sensitivity, and adaptive capacity) change because of the initiated adaptation measures. Also, a study can be conducted in similar settings and at different scales across the coastal environment of Sri Lanka and even around the globe for the purpose of comparison, the findings of which could positively contribute to the knowledge on vulnerability and adaptation. The Perception Indexes can be further validated by conducting an item analysis providing the resources, mainly time and money, are available.

As the study clearly advocates the need of awareness programmes on climate change impacts, it is important to examine closely the sources of information usually referred to and utilised by these communities and the trust they have in them. The findings of this study in that regard are limited to only self-reported sources of information. It neither analyses the reasons for people's trust in those resources nor investigates why they have such power to persist unaltered. The need to do so is apparent. The findings of such in-depth analysis may reveal the existing barriers in communication which in turn can be used to facilitate the dialogue on climate change.

However, the most immediate future research requirement identified during this study is the need for an in-depth analysis to understand how climate change and associated vulnerabilities are managed through current coastal governance, which has already proven to be inefficient and corrupted in the case of Sri Lanka. Communities such as these whose livelihoods have been specialised in one major form for generations and who are dependent upon natural resources, often require external assistance owing to the tendency of the entire systems to collapse at once with the collapse of the natural resource base. Therefore, feasibility studies to understand livelihood diversification as well as innovation options outside fishery with no or minimal impact of climate change for these communities will be highly beneficial in this critical moment. As many of the residents show interest in livestock farming yet are being constrained by the limited space and hygiene measures in place, this could be a valuable start, especially for a community which is ready to relocate.

7.11 Conclusion

According to Finucane (2009), risk is “socially constructed”. Despite the scientific descriptions that profoundly explain the aftermath of climate change impacts, Sri Lankan coastal communities’ perception in that regard seems fundamentally governed by its faith, close affinity with the fishing and associated cultural practices, the information it receives from its respected and trusted sources in social networks, and political views. Preliminary perception and appraisal, on the other hand, are proven fundamental to long-term adaptation to climate change impacts, particularly owing to their role in the decision-making process. Interventions either to reduce vulnerability or to improve adaptation purely guided by scientific descriptions are highly likely to be challenged by the community. The involvement of social scientists in IPCC’s recent work signifies the integration of social aspects in adapting to the impacts of climate change.

In addition to the scientific data that describes the types of impacts and vulnerable zones, the localised dynamics revealed through social science, as in this study provide ways that could deepen the understanding of adaptation. For example, they elucidate how gender roles change in responding to the distresses caused by climate change as women start to seek and initiate income earning activities. The study discloses both positive and negative outcomes from such endeavours. Despite better economic stability and material wellbeing of households, the damage such adaptation strategies can cause to family unity can be significant. They can rupture family unity. From a different perspective, the study also reveals how traditional fishers become isolated in a situation where nature no longer supports the knowledge they have gathered over generations. This is however counteracted to some extent by advancement in technology in fishery itself in terms of exploitation, but this also has limits. In all, this study demonstrates the power of climate change impacts to alter societal features encompassing capitals and entitlements of communities, giving rise to new livelihood vulnerabilities that may demand different adaptation avenues from those previously employed.

Most importantly, the study reveals that the coastal communities in Chilaw, Sri Lanka are unprepared socially to handle the impacts of climate change. It also suggests the need for a multifaceted approach that can tackle dimensions of vulnerabilities (exposure, sensitivity, and adaptive capacity) and identify priorities in each of them. Scoones (1998), identified three broad clusters of agricultural livelihood strategies, namely,

intensification/extensification, livelihood diversification, and migration which could also be applied to this context owing to the similarities that farmers and fishers share around the concept of “livelihood”. From that perspective, the findings clearly reveal that climate change threats have limited the livelihood strategies options of these communities to livelihood extensification (exit) and diversification as the only viable options, especially in the event that intensification and migration are ultimately recognised as impossible.

Lowry and Wickremeratne (1988, p. 263) argue that the concept of coastal management is both beguiling and elusive with coasts not yet well defined as a natural resource. While acknowledging the coast as a locus for a diverse range of living and nonliving forms, encompassing a large spectrum of human activities, they emphasize the requirement of context specific measures for addressing issues related to the border between the land and the sea. Despite the large number of organisations and policy instruments in place to address climate change impacts in Sri Lanka, the very people who are the end users and victims of their responses seem to know nothing about their initiators. Political agendas, including the desire to obtain international funding, are among perceived causes of policy fragmentation and inappropriate outcomes related to the coast. Conventional hierarchical power regimes prevailing in countries like Sri Lanka are often proven inefficient in addressing the uncertainties and complexities of social ecological systems threatened by climate change is also a large part of the blame, mainly in relation to unsustainability of the programmes of climate change impacts.

Being able to measure and provide information about the vulnerability and perceptions of climate change of people in coastal communities can assist governments and other agencies to reduce vulnerabilities through appropriate adaptation responses. However, it may not solve the challenges these people face as global warming continues to expand its impacts on the sea, the land, and the planet. While adaptation towards more pro-environmental behaviours is possible for communities who are not severely restricted by structural and cognitive barriers, it is challenging for them especially in the event that the majority are trying to make ends meet and their livelihoods largely depend on natural resources which are deteriorating due to the impacts of climate change. Thus, careful integration and assistance in finding solutions to the effects of such impacts are required. Combining science with changes in policy and practice may offer some opportunities to adjust these communities’ perceptions, decrease their vulnerability, and improve the

prospects for the Sri Lankan fishing communities and other populations who call the coast home.

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Appendix A: Subcomponents employed in the analysis together with a description, its relationship to the original model, and the referred sources in choosing those components.

Subcomponents	Description of subcomponents	Relationship to the original model	Referred Sources
Average number of floods, tornados, cyclones, tsunamis, and thunderstorms in the last six years	Total no. of floods, tornados, cyclones, tsunamis, and thunderstorms that were reported by households in the last six years	Modified	(Adu et al., 2018; Ashan & Warner, 2014; Balica et al., 2012; Birkmann et al., 2013; Gerlitz et al., 2017; Hahn et al., 2009; Madhuri et al., 2014; Rahman, 2014; Shah et al., 2013; Simane et al., 2016; Williamsburg Emergency Management, 2004)
Percentage of households affected by a natural disaster in any form	Percentage of households that reported any type of injury, death, or damage to their assets including all type of physical and financial assets	Modified	(Adu et a., 2018; Hahn et al., 2009; Madhuri et al., 2014; Rahman, 2014; Shah et al., 2013)
Average no. of empty-handed fishing trips in the last month	Average of total number of trips that each household made to the sea yet came back with insignificant or no harvest at all. A harvest that was not large enough to sell is considered insignificant.	New	KIIs, Pilot Survey
Percentage of households that do not receive any disaster management training	Percentage of households that did not receive any type of disaster management training encompassing awareness training on warning signals	New	(Adu et al., 2018; Hahn et al., 2009; Madhuri et al., 2014; Rahman, 2014; Williamsburg Emergency Management, 2004)

	and required behaviour during an emergency		
Percentage of households who firmly stated that they wouldn't obey warning signals	Percentage of households not willing to obey warning signals and go to a secure place during an emergency	New	(Ashan & Warner, 2014)
Mean standard deviation of monthly average of average maximum daily temperature (years: 1983–2010)	Standard deviation of the average daily maximum temperature by month between 1983 and 2010 was averaged for Puttalam District	Original	(Hahn et al., 2009; Rahman, 2014; Shah et al., 2013; Simane et al., 2016)
Mean standard deviation of monthly average of average minimum daily temperature (years: 1983–2010)	Standard deviation of the average daily minimum temperature by month between 1983 and 2010 was averaged for Puttalam District	Original	(Hahn et al., 2009; Rahman, 2014; Shah et al., 2013; Simane et al., 2016)
Mean standard deviation of monthly average precipitation (years: 1983–2010)	Standard deviation of the average daily minimum temperature by month between 1998 and 2003 was averaged for Puttalam District	Original	(Hahn et al., 2009; Rahman, 2014; Shah et al., 2013; Simane et al., 2016)
Percentage of households with a member suffering from a long term/recurrent disease	Percentage of households that report at least one family member with chronic illness. Chronic illness was defined subjectively by respondents as a disease that a person/s has been suffering for a long time and is being treated in a health clinic	Modified	Adu et al., 2018; Ashan & Warner, 2014; Hahn et al., 2009; Rahman, 2014; Shah et al., 2013; Vincent, 2004)

Average Dengue Fever Exposure Prevention Index	Months reported exposure to dengue fever. Owning at least one bednet indicator (have bednet = 0.5, no bednet = 1) (e.g., Respondent reported dengue is a problem January–March and they do not own a bednet = $3*1 = 3$).	Modified	(Adu et al., 2018; Hahn et al., 2009; Shah et al., 2013)
Percentage of households that miss any of children's immunisation programmes funded by the government	Percentage of households that did not immunize their children. The households that missed free of charge immunisation programme conducted by the Government for children is considered.	New	(Madhuri et al., 2014; Rahman, 2014)
Percentage of households where a family member had to miss school or work due to illness in the last two weeks	Percentage of households that report at least one family member who had to miss school or work due to illness in the last two weeks.	Original	(Adu et al., 2018; Hahn et al., 2009; Rahman, 2014; Shah et al., 2013)
Average time to health facility	Average time it takes the householders to travel to their chosen health facility.	Modified	(Adu et al., 2018; Hahn et al., 2009; Rahman, 2014; Shah et al., 2013; Simane et al., 2016)
Average waiting time in the health facility	Average waiting time in the queue until a patient is examined by a health professional. This is usually low in private practices where a patient is charged a fee, compared to the public hospitals that provides examination free of charge	New	KIIs, Pilot Survey

Percentage of households with no proper garbage disposal mechanism	Percentage of households that reported either they do not have a place to keep garbage or mention they cannot wait until the municipal council comes to collect their garbage. The provincial council that is responsible for garbage collection often fails to adhere to the routine, thus there is practice of throwing garbage either into the sea or into the lagoon.	New	KIIs, Pilot Survey, Participant Observation
Percentage of households that have no access to water sealed/ring slab latrine	Percentage of households that have no water sealed/ring slab latrine. Water sealed latrines are safer and cause fewer health problems.	New	(Ashan & Warner, 2014; Gerlitz et al., 2017; Madhuri et al., 2014; Rahman, 2014)
Average number of months households struggle to find food	Average number of months households struggle to obtain food for their family due to poor income	Original	(Adu et al., 2018; Gerlitz et al., 2017; Hahn et al., 2009; Pandey et al., 2017; World Bank, 1997)
Percentage of households that totally depend on external market for their food (except for fish)	Percentage of households that get their food primarily from the outside markets, except for fish	Modified	(Adu et al., 2018; Hahn et al., 2009; Rahman, 2014; Shah et al., 2013)
Percentage of households who usually have two meals a day	Percentage of households who report that they have no more than two meals a day. Two exceptions are the households who follow dietary requirements prescribed by a	New	KIIs, Pilot Survey

	professional or the households whose personal choice to reduce their meal to stop weight gain.		
Percentage of households with goitre, or/and anaemia, or/and night blindness that reflects food utilisation	Percentage of households with goitre, or/and anaemia, or/and night blindness which reflects food utilisation of the household	New	KIIs, Pilot Survey
Percentage of households with underweight children	Percentage of households with a child/children who is/are underweight due to malnourishment. This reflects food availability, accessibility, utilisation, and stability of the household.	New	KIIs, Pilot Survey
Percentage of households without pipe-borne water or water from their own natural resource i.e well or tube wells	Percentage of households not receiving water through the public water system or water from their own natural resources such as wells and tube wells	New	(Adu et al., 2018; Rahman, 2014; Shah et al., 2013)
Percentage of households with no consistent water supply	Percentage of households that report that water is not available at their primary water source every day	Original	(Hahn et al., 2009; Shah et al., 2013; World Bank, 1997)
Inverse of the average number of litres of water stored per household per day (range: >0–1)	The inverse of (the average number of litres of water stored by each household + 1).	Original	(Adu et al., 2018; Hahn et al., 2009)

Percentage of households with the problem of salt water intrusion	Percentage of households who reported that the water they have access to tastes salty thus they cannot drink it throughout the year, or during some parts of the year	New	KIIs, Pilot Survey
Percentage of households that buy drinking water from outside sellers	Percentage of households that mentioned they preferred to buy water from an outside seller. This includes three main groups: households with pipe borne water, yet prefer to buy from the sellers; households with natural resource that provides water yet prefer to buy from outside sellers; and households who have no access to both types.	New	KIIs, Pilot Survey
Percentage of households that reside in illegal/unauthorised dwellings including houses in the buffer zone and bank of the lagoon	Percentage of households whose dwellings are built on government owned space including the buffer zone and the bank of the lagoon.	New	(Momtaz & Asaduzzman, 2018)
Percentage of households with coconut thatched homes	Percentage of households with coconut thatched houses	New	(Gerlitz et al., 2017)
Percentage of households without electricity	Percentage of households without electricity	New	(Below et al., 2012)

Percentage of households that do not possess the deed of the land	Percentage of households who claimed that they did not possess the deed of the land during their interview	New	KIIs, Pilot Survey
Dependency Ratio	Ratio of the population under 15 and over 60 years of age to the population between 19 and 59 years of age	Modified	(Adu et al., 2018; Below et al., 2012; Gerlitz et al., 2017; Hahn et al., 2009; Islam et al., 2014; Madhuri et al., 2014; Notenbaert et al., 2013; Pandey et al., 2017; Rahman, 2014; Shah et al., 2013; Vincent, 2004)
Percentage of female-headed households	Percentage of households where the primary adult is a female	Original	(Adu et al., 2018; Below et al., 2012; Hahn et al., 2009; Madhuri et al., 2014; Notenbaert et al., 2013; Rahman, 2014; Shah et al., 2013; Simane et al., 2016;)
Average age of the female head of household	Average of ages of all female heads of households	Original	(Adu et al., 2018; Rahman, 2014; Shah et al., 2013)
Percentage of households whose head of the household did not attend school	Percentage of households where the head of the household reports that they have attended 0 years of school	Original	(Adu et al., 2018; Gerlitz et al., 2017; Hahn et al., 2009; Islam et al., 2014; Madhuri et al., 2014; Notenbaert et al., 2013; Rahman, 2014; Shah et al., 2013; Simane et al., 2016; Tjoe, 2016)
Percentage of households with orphans	Percentage of households that have at least one orphan living in their home. Orphans are children <18 years old who have lost one or both parents	Original	(Adu et al., 2018; Hahn et al., 2009)
Percentage of households with members needing dependent care	Percentage of households with at least one member requiring daily care because of age, physical or mental condition, illness, or disability	Modified	(Shah et al., 2013)

Percentage of households who never participate in skilled training (not relevant to fishing)	Percentage of households with family members who never got the chance to participate in any kind of skilled training organised by the Government that could help them to find work, such as computer science and mechanics (other than fishing and related businesses)	New	KIIs, Pilot Survey
Percentage of male-headed households where housewives have recently started sharing the financial burden or/and in the process of finding ways to do that	Percentage of male-headed households where housewives have recently (during the last year) started sharing a financial burden or/and are in the process of seeking livelihoods or employment by asking either politically or financially powerful people to find a job for them because of contemporary threats to the main livelihood. This trend could largely affect the overall wellbeing of the family where males have become addicted to alcohol and females may miss some of their children's duties as well their own wellbeing. Thus, the social cost of this practice is assumed to outweigh its financial benefits which eventually increase their livelihood vulnerability.	New	(Adu et al., 2018; Madhuri et al., 2014)

Percentage of households without members working outside the community	Percentage of households that claim none of their family members work outside of the community for their primary work activity.	Modified	(Ashan & Warner, 2014; Hahn et al., 2009; Shah et al., 2013)
Average Fishery Livelihood Diversification Index	The inverse of (the number of fishery and related livelihood activities +1) reported by a household, e.g., A household that fishes, raises livestock, and collects natural resources will have a Livelihood Diversification Index = $1/(3 + 1) = 0.25$	Modified	(Adu et al., 2018; Gerlitz et al., 2017; Hahn et al., 2009; Rahman, 2014; Shah et al., 2013; Tjoe, 2016)
Percentage of households that do not own assets that they utilise for their livelihoods	Percentage of households that are in the cycle of getting money from money lenders at a very high interest rate for their livelihood activities. Thus, are unable to secure a considerable part of their income	New	KIIs, Pilot Survey
Percentage of households that rely on money lenders for their usual livelihood activities	Percentage of households who do not own assets that they utilise for their livelihoods	New	KIIs, Pilot Survey
Average Occupational Diversity Index	The inverse of (the number of earning members of household +1)	New	(Rahman, 2014)
Average Receive: Give ratio	Ratio of (the number of types of help received by a household in the past month + 1) to (the number of types of help given by a household to someone	Original	(Adu et al., 2018; DHS, 2006; Hahn et al., 2009; Pandey et al., 2017; Rahman, 2014; Shah et al., 2013)

	else in the past month + 1). This excludes any type of financial assistance.		
Average Borrow: Lend ratio	Ratio of a household borrowing money in the past month to a household lending money in the past month, e.g., if a household borrowed money but did not lend money, the ratio = 2:1 or 2 and if they lent money but did not borrow any, the ratio = 1:2 or 0.5.	Original	(Hahn et al., 2009; Pandey et al., 2017; Shah et al., 2013; World Bank, 1997)
Percentage of households that do not hold a membership in a Community Based Organisation (CBOs)	Percentage of households that do not hold a membership in a Community Based Organisation (CBOs) including cooperative societies and/or any form of society that is representative of a semi-formal financial sector such as Fisheries Cooperative Societies; Women's society; Sarvodaya societies; Women's societies belonging to the Small Fisheries Federation; societies that are representative of any political party; Funeral Aid societies; and societies formed by the Church.	New	(Kelegama, 2014; Simane et al., 2016)
Percentage of households that have not gone to their local government for	Percentage of households that have not asked their local government for assistance in the past 12 months. This	Original	(Hahn et al., 2009; Pandey et al., 2017; Rahman, 2014; Shah et al., 2013; WHO/RBM, 2003)

assistance during the last 12 months	includes visits to any government offices including the AGA office and GN office.		
Percentage of households that have never taken a loan from the formal banking sector	Percentage of households that have never taken a loan from the formal banking sector, excluding cooperative societies and insurance companies. This includes banks, leasing, and finance companies regulated by central bank of Sri Lanka.	New	(Kelegama, 2014)
Percentage of households with members who could not secure an occupation due to political influence despite their qualifications	Percentage of households with members who could not secure an occupation due to political influence despite their qualifications	New	(Islam et al., 2014)
Percentage of households that did not vote during the last local election	Percentage of households in which none of its members voted during the previous local election held in September 2013	New	(Ashan & Warner, 2014; Islam et al., 2014)

Appendix B: Livelihood Vulnerability Survey Questionnaire

Questionnaire: Livelihood Vulnerability Survey

Curtin University Sustainability Policy Institute (CUSP)

Curtin University

Western Australia, Australia

Identification Information

Date:

Household (HH) number:

GN Division:

Result Code:

Completed	1
Housing unit is temporarily closed	2
Housing unit is demolished/vacant	3
Other (specify).....	99

Interviewers Name:

Interviewers Signature:

Section 1: Socio-Demographic Profile

Serial No:	1.1. Name of all persons who usually live (both sleeps and eats) in this household. Serial number 1 is always the interviewee	Relationship to head of household— head/wife/ husband/son/daughter/son in law etc.	Gender (M/F/Other)	Age (as of previous birthday)	Marital Status Single/Widowed/Divorcee/ Separated	Level of education—including children over five years	Income sources (if there is more than one, please write it down. For children, please note if they attend school)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
1.8. Details of members of the household living abroad but who visit home and/or contribute to income (mention the country in the column of 1.7)							
1							
2							
3							

1.9. Do you have any children from other families living in your house because one or both of their parents has died/ left/ do not look after them (18 years old or below 18 years)?

1. Yes 2. No

1.10. In which locality do you work? (If you work in both your locality and a different locality please select both.)

1. Same locality 2. Different locality 3. Both

1.11. Is anyone in your family (mentioned in 1.1) chronically ill and attending hospital clinics for treatment? (If a person is only a member of a government clinic, answer “yes”)

1. Yes 2. No

1.12. Does anyone in your family (mentioned in 1.1) require daily care from another person because of age, physical, or mental condition, illness, or disability?

1. Yes 2. No

1.13. Has anyone in your family (mentioned in 1.1) ever had the opportunity to participate in a training in a different skill other than fishing?

1. Yes 2. No

Section 2: Livelihood Assets and Practices

2.1. Is the household supported by food generated within the household?

1. Livestock 2. Crops 3. Both 4. None

99. Other (Please specify)

2.2. Do the assets that you use for your main income source/ livelihood (e.g., boat, other required equipment) belong to you?

1. Yes 2. No 3. Some of them 4. Not applicable

99. Other (Please specify)

2.3. Do you own any other income generating assets (as in 2.4) here or somewhere else?

1. Yes 2. No

2.4. If yes, select from below

1. Three-wheeler 2. Another house (on rent) 3. Fish outlet (on rent) 4.

Cultivable land

99. Other (Please specify)

2.5. What practices did you or anyone in your family change to gain income during the last ten years? (You may have not done the practice throughout the entire period. If you did the practice at least once during last ten years, please mark it as a yes).

1	Time of work
2	Place of work
3	Assets/equipment use for the work

4	Method of doing the work
5	Methods of storing
6	Method of selling/marketing
7	Shifted to a completely different livelihood within the same locality (temporarily/permanently)
8	Migrated to a different locality for the same livelihood (temporarily/permanently)
9	Migrated to a different locality for a different livelihood (temporarily/permanently)
10	Started working on another income source other than the main income
11	Housewives in particular: either looked for alternative income sources or became more involved in such activities
12	Nothing changed
13	Other (Please specify)

2.6. Why have you changed your practices (for what reasons)?

1. Market

2. Government subsidized schemes

3. Availability of resources (except for government support)

4. Non-availability of resources

5. Climate/weather related stressors

6. Other (please specify)

.....

2.7. What is your principal type of cooking fuel?

1. Firewood

2. Kerosene

3. Sawdust/paddy husk

4. Gas

5. Electricity

6. Other (Please specify)

2.8. Did you frequently migrate to other areas during last ten years as a part of earning your main livelihood?

1. Yes

2. No

2.9. Do you often seek the assistance of money lenders for your usual livelihood activities?

1. Yes

2. No

Section 3: Health

3.1. Where do you go to when you have a normal illness? (Choose the place where you often visit.)

- 1. Public hospital
- 2. Public dispensary
- 3. Private hospital/channel centre
- 4. Private Doctor
- 99. Other (Please specify)

3.2. How long does it take for you to get to that health facility (choose the time it takes for you to get there)?

- 1. 1-10 mins
- 2. 11-20 mins
- 3. 21-30 mins
- 4. 31-40 mins
- 5. 41-60 mins
- 6. More than 60 mins

3.3. What mode of transport do you use (referring to 3.2 above)?

- 1. Walk 2. Bicycle 3. Motorbike 4. Three-wheeler 5. Public transport
- 99. Other (Please specify)

3.4. What is the waiting time at the health services that you have access to (referring to 3.1 above)?

- 1. 1-15mins 2. 15-30mins 3. 30-45mins 4. 45-60mins 5. More than 60mins

3.5. Has anyone in your family been so sick in the past two weeks that they had to miss work or school?

1. Yes 2. No

3.6. Do you have enough mosquito nets for all family members?

1. Yes 2. No

3.7. Has anyone in your family suffered from dengue fever in the last year?

1. Yes 2. No

3.8. Did any of your children miss government supported immunisation programs?

1. Yes 2. No

3.9 How does the household dispose of garbage? (Select all that apply)

1. Collected by garbage truck
2. Burned within premises
3. Dumped within premises
4. Dumped/thrown away outside premises
5. Dumped into the beach
6. Dumped into the lagoon
7. Processed for fertilisers
99. Other:

3.10. What type of toilet facility is available for you?

1. We have no latrine of our own

2. Water sealed/ring slab latrine

3. A toilet with a commode

99. Other (Please specify)

Section 4: Socio-Political Networks

4.1. Did you borrow any money from relatives or friends in the past month?

1. Yes 2. No

4.2. Did you lend any money to relatives or friends in the past month?

1. Yes 2. No

4.3. In the past month, did you and/or your family help relatives or friends?

1. Yes 2. No

4.4. In the past month, did you and/or your family receive any help from relatives or friends?

1. Yes 2. No

4.5. Are you (or a household member) a member of any of the community organizations in your locality?

1. Yes 2. No

4.6. Have you ever received any help from those?

1. Yes 2. No

4.7. In the past 12 months, have you or someone in your family gone to agency of government or community organisation for help?

1. Yes 2. No

4.8. Have you ever received any aid (either from the Government or any other organisation) in time of need?

1. Yes 2. No

4.9. Have you ever taken any loan from a formal financial institution (usually a bank)?

1. Yes 2. No

4.10. Have you ever lost a job opportunity that suits your qualifications due to political influence?

1. Yes 2. No

4.11. Did any of the members of your household purposely avoid voting during the last local election held in September 2013?

1. Yes 2. No

4.12. In what kind of social functions do you participate, and how often?

Function	How often						
	1	2	3	4	5	6	99
1. Church/religious function	Once a year	Twice a year	3 times a year	4 times a year	5 times a year	6 times a year	Other (Please specify)
2. Family/relative related	Once a year	Twice a year	3 times a year	4 times a year	5 times a year	6 times a year	Other (Please specify)

3. Gatherings of friends	Once a year	Twice a year	3 times a year	4 times a year	5 times a year	6 times a year	Other (Please specify)
4. Arranged by formal organisation	Once a year	Twice a year	3 times a year	4 times a year	5 times a year	6 times a year	Other (Please specify)
5. Other (Please specify)	Once a year	Twice a year	3 times a year	4 times a year	5 times a year	6 times a year	Other (Please specify)

Section 5: Food and Shelter

5.1. Where does your family get most of its food?

- 1. Home garden
- 2. Fair
- 3. Retail shops
- 4. Wholesale shops
- 5. Town market
- 6. Supermarkets
- 99. Other (Please specify)

5.2. Are there times during the year that your family does not have enough income for family needs?

Month	Poor income	Have 3 or more meals a day	Have 2 meals a day	Have less than 2 meals a day
January	Yes / No	Yes / No	Yes / No	Yes / No
February	Yes / No	Yes / No	Yes / No	Yes / No
March	Yes / No	Yes / No	Yes / No	Yes / No
April	Yes / No	Yes / No	Yes / No	Yes / No
May	Yes / No	Yes / No	Yes / No	Yes / No
June	Yes / No	Yes / No	Yes / No	Yes / No
July	Yes / No	Yes / No	Yes / No	Yes / No
August	Yes / No	Yes / No	Yes / No	Yes / No
September	Yes / No	Yes / No	Yes / No	Yes / No
October	Yes / No	Yes / No	Yes / No	Yes / No
November	Yes / No	Yes / No	Yes / No	Yes / No
December	Yes / No	Yes / No	Yes / No	Yes / No

5.3. Do you store any type of food to consume during hard times? 1. Yes 2. No

Yes	What?
No	Why?

5.4. Does any member of your family suffer from any of the following illnesses/diseases?

1. Malnutrition

2. Anaemia

3. Colour blindness

4. Vitamin A deficiency

5. Kidney diseases

99. Other (Please specify)

5.5. Have any of your children been reported as underweight by the midwife?

1. Yes 2. No

5.6. Who is the legal owner of this land that your house is built on?

1. Member/s of the Household 2. The Government

99. Other (Please specify)

5.7. Do you possess the deed of this property that may be useful in obtaining a loan?

1. Yes 2. No

Section 6: Water

6.1. Where do you collect your drinking water from?

- 1. Own well
- 2. Own water line (government provided)
- 3. Neighbours/ friends
- 4. Common water sources including taps
- 5. Water bowsers (government)
- 6. Private water supplier
- 7. Supermarkets/shops
- 99. Other (Please specify)

6.2. How long does it take to get to your drinking water source (mins)?

- 1. 1–30 mins
- 2. 31–60 mins
- 3. 61–120 mins (1 to 2 hours)
- 4. More than 120 mins (more than 2hours)

6.3. Is this water available every day?

- 1. Yes
- 2. No

6.4. How much do you pay for water per month?

- 1. Government water bill (Rs).....
- 2. Other sources (Rs).....

6.5. What containers do you usually store water in (mention the size of the container and how many of them), and for how many days?

Container Type	Size	Number of containers	Number of days

6.6. Where do you get water for the purpose of cooking?

1. Own well
2. Own water line (government provided or from own sources)
3. Neighbours/ friends
4. Common well/common water sources
5. Water bowsers (government)
6. Private water supplier
7. Supermarkets/shops
99. Other (Please specify)

6.7. What do you do during the times of saltwater intrusion or during the time of a saline water problem (for drinking/cooking)? Answer only if you have that problem.

1. Own well
2. Own water line (government provided or from own sources)
3. Neighbours

- 4. Common well/common water sources including taps
- 5. Water bowsers (government)
- 6. Private water supplier
- 7. Supermarkets/shops
- 99. Other (Please specify)

6.8. What do you do during the times of saltwater intrusion or during the time of a saline water problem (for farming & livestock)? Answer only if you have that problem

- 1. Own well
- 2. Own water line (government provided or from own sources)
- 3. Neighbours
- 4. Common well/common water sources including taps
- 5. Water bowsers (government)
- 6. Private water supplier
- 7. Supermarkets/shops
- 99. Other (Please specify)

Section 7: Natural Disasters, Climate Variability, Warnings, and Impacts (during the last six years starting from 2008 January)

7.1. Was this house affected by any of following natural disasters/climate weather related stressors? (Please mark how many times each household has been affected by the disasters during the last six years)

- 1. Shoreline erosion
- 2. Flood
- 3. Strong winds
- 4. Cyclones
- 5. Tornados
- 6. Lightning
- 7. Tsunami

99. Other (Please specify)

7.2.1. Did you receive a warning before any of the disasters you noted in question 7.1 happened?

1. Yes 2. No

7.2.2. Will you obey warning signals if they are given next time?

1. Yes 2. No

7.3. Was anyone in your family injured in any of the disasters you noted in question 7.1?

1. Yes 2. No

7.4. How were your house and other physical assets affected during the disasters you marked in question 7.1?

1. No damage 2. Damage to roof 3. Damage to walls
4. Damage to the floor 5. Loss of the house 6. Damage to the boat
7. Damage to equipment used in the livelihood

99. Other (Please specify)

7.5.1. How was your livelihood affected?

1. No damage 2. Less harvest 3. Drop in the market
4. Loss of tools/equipment 5. Loss of livelihood—temporarily
6. Loss of livelihood—permanently

99. Other (Please specify)

7.5.2. During last month, how many fishing trips ended with no harvest at all? (Write the number)

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7.6. In your own opinion do you think that your family has recovered from such stressors?

1. Yes 2. No 3. I don't know

7.7 What helped your family to recover? What would have helped you recover better?

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7.8. As a result of such disasters/ weather related stressors/ climate change impacts, how often do you need to renew or buy any tools or equipment that support your livelihood?

1. Once a month 2. Once in 3 months
3. Once in 6 months 4. Once in 9 months
5. Once a year

99. Other (Please specify)

7.9. How often do you have to renew/rebuild your house or part of your house due to the damage caused by natural disasters/climate weather related stressors?

1. Once in 3 months 2. Once in 6 months 3. Once in 9 months 4. Once a year

99. Other (Please specify)

7.10. Are you aware of (or have you ever participated in) any government programmes that try to minimise or stop the damage from natural disasters/climate weather related stressors?

1. Yes 2. No

7.11. If yes, what are they? (Please list them)

- 1.....
- 2.....
- 3.....
- 4.....
- 5.....
- 6.....

7.12 If no, why not?

Appendix C: Calculating the Food major component for the LVI of *Kurusapaduwa*

No	Subcomponent of Food	Subcomponent Minimum values for <i>Kurusapaduwa</i> Values	Maximum Subcomponent Values	Index Value for <i>Kurusapaduwa</i>	
1	Average number of months household struggles to find food	6.04	3	7	0.76
2	Percentage of households who totally depend on external market for their food (except for fish)	100	0	100	1
3	Percentage of households who usually have two meals a day	80	0	100	0.8
4	Percentage of households with goitre or/and anaemia or/and night blindness that reflects food utilisation	8	0	100	0.08
5	Percentage of households with underweight children	12	0	100	0.12

Food Major component value for *Kurusapaduwa*= 0.552

Step 1: (Repeat for all subcomponent indicators)

Equation 9

$$\text{Index}_{S_d} = \frac{S_d - S_{\min}}{S_{\max} - S_{\min}}$$

$$\text{Index}_{\text{Food}_{\text{Kurusapaduwa}}} = \frac{6.04 - 3}{7 - 3} = 0.76$$

Step 2: (Repeat for all major components)

Equation 10

$$M_d = \frac{\sum_{i=1}^n \text{Index}_{S_d^i}}{n}$$

$$\text{Food}_{Kurusapaduwa} = \frac{0.76+1+0.8+0.08+0.12}{5} = \mathbf{0.552}$$

Step 3: (Repeat for all study areas)

Equation 11

$$LV\vec{I}_d = \frac{\sum_{i=1}^8 w_{Mi} M_{di}}{\sum_{i=1}^8 w_{Mi}} \quad \text{or}$$

$$LV\vec{I}_d = \frac{w_{NDCVWI}NDCVWI_d + w_{HH}H_d + w_{FF}F_d + w_{WW}W_d + w_{SS}S_d + w_{SDP}SDP_d + w_{LAP}LAP_d + w_{SPN}SPN_d}{w_{NDCVWI} + w_{HH} + w_{FF} + w_{WW} + w_{SS} + w_{SDP} + w_{LAP} + w_{SPN}} \quad (3)$$

$$\begin{aligned} & LV\vec{I}_{Kurusapaduwa} \\ &= \frac{(8 * 0.577) + (8 * 0.289) + (5 * 0.552) + (5 * 0.162) + (4 * 0.258) + (7 * 0.270) + (6 * 0.421) + (7 * 0.372)}{(8 + 8 + 5 + 5 + 4 + 7 + 6 + 7)} \\ &= 0.371 \end{aligned}$$

Appendix D: Calculating LVI–IPCC for *Kurusapaduwa*

Contributing factors	Major components for <i>Kurusapaduwa</i>	Major components value for <i>Kurusapaduwa</i>	Number of subcomponents per major component	Contributing factor values
Adaptive capacity	Socio-Demographic Profile	0.270	7	0.554
	Livelihood Assets and Practices	0.421	6	
	Socio-political Networks	0.372	7	
Sensitivity	Health	0.289	8	0.314
	Food	0.552	5	
	Water	0.162	5	
	Shelter	0.258	4	
Exposure	Natural Disasters, Climate Variability, Warnings, and Impact	0.577	8	0.577

LVI-IPCC value for *Kurusapaduwa* = **0.0074**

Step 1 (calculate indexed sub-component indicators and major components as shown in Appendix C, taking the inverse of the adaptive capacity sub-component indicators that comes under major components of SocioDemographic Profile, Livelihood Assets and Practices, and Socio-political Networks).

Step 2 (repeat for all contributing factors: Exposure, Sensitivity, and Adaptive Capacity):

Equation 12

$$CF_d = \frac{\sum_{i=1}^n w_{Mi} M_{di}}{\sum_{i=1}^n w_{Mi}}$$

$$Adaptive\ Capacity_{Kurusapaduwa} = \frac{(7*0.609+6*0.507+7*0.538)}{(7+6+7)} = \mathbf{0.554}$$

Step 3 (repeat for all study areas):

$$LVI-IPCC_d = (e_d - a_d) * (s_d) \quad (3)$$

$$LVI-IPCC_{Kurusapaduwa} = (0.577 - 0.554) * (0.314) = \mathbf{0.0074}$$

Appendix E: Calculation of perception index for “Understanding-Causes”

No	Item	Choices/alternatives (responses of all 206 participants)					Mean Score
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)	
2	PI of Understanding Causes						
2.1	Climate change is mainly a result of human activities	9	89	41	66	1	0.095
2.2	Fossil fuel burning and deforestation contribute to climate change	0	1	175	29	1	-0.073
2.3	I have heard about GHGs	0	1	0	204	1	-0.498

PI of Understanding causes = -0.158

Step 1: Calculation of mean score for each statement (Repeat for all statements)

Equation 13

$$\hat{X} = \frac{\sum f_{ij}x_{ij}}{n}$$

$$\text{Mean score of perception statement} = \frac{(1*9)+(0.5*89)+(0*41)+(-0.5*66)+(-1*1)}{206} = \mathbf{0.095}$$

Step 2: Calculation of PI for the dimension of Understanding-Causes (Repeat for all dimensions)

Equation 14

$$PI_d = \frac{\sum \frac{f_{ij}x_{ij}}{n}}{\text{No of perception statements}}$$

$$PI_{\text{Understanding-Causes}} = \frac{(0.095)+(-0.073)+(-0.498)}{3} = \mathbf{-0.158}$$

Appendix F: Knowledge, Attitude, and Practice (KAP) Survey Questionnaire

Questionnaire: KAP Survey

Curtin University Sustainability Policy Institute (CUSP)

Curtin University

Western Australia, Australia

Identification Information:

Date: GND:

Livelihood:

Household No:

Name of Head of the household.....

Interviewer (name): Interviewer Signature:

Q1: What issues (relevant to your livelihood and wellbeing) trouble you the most?

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Q2. How are you responding to all these concerns that you mention in Q1?

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Q3. What do you think are the causes of those that you mention?

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Q4. How would you rate your ability to read or feel the changes in the natural environment that you live in?

1. Very Poor 2. Poor 3. Average 4. Good 5. Excellent

Q5. From where do you usually hear about ¹³Climate Change?

- 1. Newspapers
- 2. Television/Radio
- 3. Internet/FB
- 4. Neighbours/Friends
- 5. Organisation representatives
- 6. Children who are schooling
- 7. Church sermons
- 99. Other.....

Q6. Who do you feel is most responsible for initiating a response for negative impacts of climate change?

- 1. State Government
- 2. Local government
- 3. Community
- 4. Scientists
- 5. International organisations
- 6. Multinational companies/big factories
- 99. Other.....

Q7. Are you satisfied with the actions taken by the government (both state and local) to minimise impacts of climate change on your livelihoods?

- 1. Unsatisfied
- 2. Less than satisfied
- 3. Satisfied
- 4. Highly satisfied

Q8. Are you worried about climate change?

- 1. Yes
- 2. No
- 3. No idea/I don't know

Q9. Are you curious about what is with climate change?

- 1. Yes
- 2. No
- 3. No idea/I don't know

¹³ Climate refers to the long-term pattern of weather in a particular region over a period of 30 years. When scientists talk about climate, they are looking at averages of precipitation, temperature, humidity, sunshine, wind velocity, tidal changes in the sea and species reduction. Climate change refers to change in long term averages of daily weather.

Q10. From which source do you hear about weather or climate related matters?

- 1. Newspapers
- 2. Television/radio
- 3. Internet/Facebook
- 4. Neighbours/friends
- 5. Organisation representatives
- 6. Children who are schooling
- 7. Church sermons
- 99. Other (please specify)

Q11. Please make one choice under each statement.

No	Item	Choices/Alternatives				
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)
1	PI of Attitude and Awareness					
1.1	I have heard the term “climate change”					
1.2	Climate change is real					
1.3	We pay attention to climate change related news					
1.4	Climate change is a threat to our lives					
1.5	Climate change is a threat to our livelihoods					
1.6	Climate change can damage physical infrastructure					
1.7	Government/Pvt/NGO representatives talk to us about climate change impacts					
1.8	We talk about climate change (among us)					
1.9	We are aware about that our country has an adaptation plan					

Q12. Please make one choice under each statement.

No	Item	Choices/Alternatives				
		SA (1)	A (0.5)	N/IDK (0)	DA (- 0.5)	SDA (- 1)
3	PI of Familiarity and Experience with Impacts and Exposure					
3.1	Fish stocks are declining					
3.2	Fishing seasons are having anomalies					
3.3	Sea level is rising					
3.4	Beach erosion is increasing					
3.5	Atmospheric temperature is increasing					
3.6	Rainfall anomalies are increasing					
3.7	Wind speed is increasing					
3.8	Wind direction is showing abnormalities					
3.9	Lightning is becoming frequent					
3.10	Lightning is becoming scary					
3.11	Floods are becoming frequent					
3.12	Floods are becoming intense					
3.13	Cyclones are becoming common					
3.14	Tornados are becoming common					
3.15	Risk of occurrence of tsunami					

Q13. Please make one choice under each statement.

No	Item	Choices/Alternatives				
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)
2	PI of Understanding-Causes					
2.1	Climate change is mainly a result of human activities					
2.2	Fossil fuel burning and deforestation contribute to climate change					
2.3	I have heard about GHGs					

Q14. Please state one choice under each statement.

No	Item	Choices/Alternatives				
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)
4.1	PI of Sensitivity					
4.1.1	I have secure access to food					
4.1.2	I have secure access to water					
4.1.3	I have secure access to shelter					
4.1.4	I have secure access to health facility					

Q15. Please make one choice under each statement.

No	Item	Choices/Alternatives				
		SA (1)	A (0.5)	N/IDK (0)	DA (-0.5)	SDA (-1)
5.0	PI of Perceived Adaptation efficacy and Perceived Self efficacy					
5.1	God will protect us					
5.2	We need to adapt					
5.3	We think we made positive differences in our livelihoods that may assist the stresses of climate threats					
5.4	I have enough knowledge and skills to adapt					
5.5	I have reliable access to family/friends/ cooperatives for assistance					
5.6	I have a reliable income					
5.7	I have reliable access to other income sources/savings/credit					
5.8	I have enough movable/immovable assets to survive during a hardship					
5.9	We have better roads/markets/transportation					
5.10	We have enough resources to evacuate during a disaster					
5.11	My rights are protected by public institutions (enforcement of law)					

5.12	I am acknowledged and included in the decision-making process by formal institutions					
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