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DEDICATION

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Abbreviations

Abbreviation	Definition
	IPCC Fourth Assessment
AR4	Report
	IPCC Fifth Assessment
AR5	Report
CC	Climate Change
CLM	Conditional Logit model
CM	Choice Modelling
	Choice Modelling
CMA	Approach
CO2	Carbon dioxide
	Contingent Valuation
CVM	Model
	Environmental Protection
EPA	Agency
	Feasible Generalized Least
FGLS	Square
GDP	Gross Domestic Product
GHC	Ghana Cedis
GHG	Green House Gases
	Ghana Living Standard
GLSS5	Survey round 5
	Ghana Living Standard
GLSS7	Survey round 7, 2017
	Global Mean Sea Level
GMSL	Rise
GPS	Global Positioning System
H2O	Hydrogen
HH	Household
	Intergovernmental Panel
IPCC	on Climate Change
	National Aeronautics and
NASA	Space Administration
	Non-Governmental
NGOs	Organizations
	National Geographic
NGS	Society
	National Insurance
NIC	Commission
	National Oceanic and
	Atmospheric
NOAA	Administration
OLS	Ordinary Least Square
RCP2	Representative

	Concentration Pathway
RUT	Random Utility Theory
	Sustainable Development
SDGs	Goals
SLR	Sea Level Rise
UN	United Nations
	United Nations,
	Department of Economic
UNDESA	and social Affairs
	United Nations Framework
	Convention on Climate
UNFCCC	Change
	Vulnerability as expected
VEP	poverty
	Vulnerability as exposure
VER	to risk
	Vulnerability as expected
VEU	low utility
VIF	Variable Inflation Factor
	West Africa Coastal Areas
WACA	Management Program
WRI	World Resource Institute
WSLR	World Sea Level Rise
WTA	Willingness to Accept
WTP	Willingness to Pay

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Abstract

Rising sea levels is exacerbating coastal floods and threatening the survival of coastal communities. As global sea level rises, the action of waves at higher elevations enhances the likelihood of coastal erosion and already, coastal erosion is causing millions per year for coastal property loss. The situation affects daily livelihood activities and could aggravate problems of unemployment and poverty. The main objective of the study aimed at examining the economic impact of sea level rise on the livelihood of the coastal region in Ghana. Specifically, the study sought to examine the perception and coping capabilities of the people who live in the coastal region. The study again, sought to assess the cost of sea level rise to the coastal region using the willing using their willingness to pay. And finally, to measure the vulnerability to poverty of the people in the coastal region. Survey questionnaire was employed to collect data from the study area notably, 4 communities in the Ketu South and Keta Municipalities in the volta region of Ghana. The rbiprobit regression model as well as the logistic regression were used to explore the perception and coping capabilities of people in the coastal region. Choice modeling was used to assess the willingness to pay of insurance packages to estimate the cost of sea level rise while a three-step Feasible Least Square (FGLS) estimation procedure was employed to estimate the vulnerability to poverty. The results of the analyses showed that people perceive sea level rise as happening while they perceive climate to be the cause though they are unable to cope with the impact. Location, livelihood activity, displacement, age, income and number of persons in a household significantly affect their perception and coping capabilities. Again, people are willing to pay for insurance packages to help as a form of coping mechanism and building resilience however, male household heads have higher willingness to pay for insurance policies as compared to female household heads. Also, more than half of respondents are vulnerable to extreme poverty while about 99% of respondents are vulnerable to poverty using the upper poverty line. Based on the results obtained, the study recommends that government and respective authorities put in measures to implement coping mechanisms as well as enforcing strengthening existing ones. Respective authorities could consider implanting insurance policies to help deal with losses due to sea level rise while considering subsidizing premiums of insurance packages to ensure victims are able to afford.

Résumé

L'élévation du niveau de la mer exacerbe les inondations côtières et menace la survie des communautés côtières. À mesure que le niveau mondial de la mer augmente, l'action des vagues à des altitudes plus élevées augmente la probabilité d'érosion côtière et déjà, l'érosion côtière cause des millions de dollars par an pour la perte de propriétés côtières. La situation affecte les activités de subsistance quotidiennes et pourrait aggraver les problèmes de chômage et de pauvreté. L'objectif principal de l'étude visait à examiner l'impact économique de l'élévation du niveau de la mer sur les moyens de subsistance de la région côtière du Ghana. Plus précisément, l'étude visait à examiner la perception et les capacités d'adaptation des personnes qui vivent dans la région côtière. Encore une fois, l'étude a cherché à évaluer le coût de l'élévation du niveau de la mer pour la région côtière en utilisant la volonté de payer. Et enfin, mesurer la vulnérabilité à la pauvreté des populations de la région côtière. Le questionnaire d'enquête a été utilisé pour collecter des données dans la zone d'étude, à savoir 4 communautés dans les municipalités de Ketu Sud et de Keta dans la région de la Volta au Ghana. Le modèle de régression biprobit ainsi que la régression logistique ont été utilisés pour explorer la perception et les capacités d'adaptation des habitants de la région côtière. La modélisation des choix a été utilisée pour évaluer la volonté de payer des forfaits d'assurance afin d'estimer le coût de l'élévation du niveau de la mer, tandis qu'une procédure d'estimation des moindres carrés réalisables (FGLS) en trois étapes a été utilisée pour estimer la vulnérabilité à la pauvreté. Les résultats des analyses ont montré que les gens perçoivent l'élévation du niveau de la mer comme se produisant alors qu'ils perçoivent le climat comme la cause bien qu'ils soient incapables de faire face à l'impact. L'emplacement, l'activité de subsistance, le déplacement, l'âge, le revenu et le nombre de personnes dans un ménage affectent de manière significative leur perception et leurs capacités d'adaptation. Encore une fois, les gens sont prêts à payer pour des forfaits d'assurance pour aider comme une forme de mécanisme d'adaptation et de renforcement de la résilience, cependant, les hommes chefs de ménage sont plus disposés à payer pour les polices d'assurance que les femmes chefs de ménage. En outre, plus de la moitié des répondants sont vulnérables à l'extrême pauvreté tandis qu'environ 99 % des répondants sont vulnérables à la pauvreté en utilisant le seuil de pauvreté supérieur. Sur la base des résultats obtenus, l'étude recommande que le gouvernement et les autorités respectives mettent en place des mesures pour mettre en œuvre des mécanismes d'adaptation ainsi que pour renforcer ceux qui existent déjà. Les autorités

respectives pourraient envisager d'implanter des polices d'assurance pour aider à faire face aux pertes dues à l'élévation du niveau de la mer tout en envisageant de subventionner les primes des forfaits d'assurance pour s'assurer que les victimes sont en mesure de payer leur achat.

Introduction

One of the most severe impacts of climate change is sea level rise (Darwin & Tol, 2001; Bosello, et al., 2007; Bosello, et al., 2012). Earlier works such as that of (Watkiss, 2011) have identified the effects of sea level rise to cause major economic damages. The rising sea levels is exacerbating coastal floods and threatening the survival of coastal communities. Infrastructure is being destroyed around coastal areas and activities such as, fishing, tourism, agriculture among others is being threatened (Michael, 2007; Mima & Criqui, 2011; Chen, et al., 2012; Steiger, et al., 2020). Consequently, these impacts on coastal areas are affecting livelihoods of coastal citizens leading to low incomes and in extreme cases, unemployment. Unemployment may affect the dependency ratio of various economies and accordingly, a threat to food security. The effects that these coastal regions experience as a result of rising sea levels could also affect the inland regions through movement of labor and trade hence, leading to disparity in regions. Thus, some coastal dwellers are driven to inland regions as a result of closed businesses, reduced wages and flooding of homes. Sea level rise could also aggravate by unemployment while driving people to developing inland regions and most likely converting mega cities into middle-scale cities (Cui, et al., 2018). In essence, economies suffer greatly as a result of sea level rise as coastal communities and even inlands are negatively affected through various physical shocks.

Climate change is the biggest market failure the world has ever seen (Stern, et al., 2006). It is the mother of all externalities: larger and more complex, and more uncertain than any other environmental problem (Tol, 2009; Chenkov-Shaw, 2019). Several studies have sought to reflect on the idea behind externality, the classic case of market failure thus, arriving at various definitions by authors (Hanley & White, 2007). According to (Arrow, 1969), externalities exist in a situation where a private economy is insufficient in incentives to create a potential market in some good, and there's loss of efficiency as a result of the nonexistence of market rights. Again, externalities occur when the welfare of an economic agent (household or firm) depends not only on its activity but also on the activity of another agent's activity without any transaction taking place to repair the damage or withdraw the benefits created (Tietenberg & Lewis, 2014). The emissions of Greenhouse Gases (GHG) are as a result of externalities (Harris, et al., 2017) emanating from economic activities. The industrial revolution has been characterized by increase GHG emissions which have enhanced the heat-trapping capability of the earth according to the

stern review report (Stern, et al., 2006). Thus, economic growth unintendedly is producing troubling changes in the climate and earth system.

In making economic analysis of climate change, greenhouse gasses GHGs which cause warming of the planet and other changes in the weather pattern are considered as both causes of environmental externality and a case of over usage of a common property resource (Harris, et al., 2017). That is, the atmosphere is a global common property into which individuals as well as firms release pollution whereby the pollution affects everyone irrespective of whether they caused it or not thus, a negative externality with a great impact. Externalities stem from lack of market for some goods and lack of clearly defined property. Furthermore, externalities perturb the first theorem of welfare economics (Laffont, 1989) hence, affecting the welfare of people in the society. Welfare is affected by climate change in terms of utility, productivity, labor supply and depreciation. Also, climate change impacts the entire planet and the impacts may exist for decades and even centuries. The phenomenon is pernicious as it involves so many daily life activities. Hence, the need to find viable solutions to which the Intergovernmental panel on climate change (IPCC) and other climate change institutions are keen on. For instance, the IPCC has since 1988 been strenuously finding ways to tackle the issues of climate change (Hinkel, et al., 2015).

Nonetheless, solving the problem of externalities, involve clearly defining property rights as well as creating a market. It is however important to mention that solving climate change involves collective efforts as individual efforts may prove futile (Nordhaus, 2019). Often, the general approaches to environmental policy making encompass: command and control regulation, market-based incentives, hybrid approaches and voluntary initiatives (Heinzerling, 2012). A country may not be incentivized to reduce local emissions of pollutants (CO₂) in the same way a private producer in search of profits may also not be incentivized to also clean and protect the environment. As a result of this, economists suggest the use of command-and-control approaches to incentivize economic agents (Hanley & White, 2007; Tietenberg & Lewis, 2014). It is essential to ensure palpable policy solutions to force activities that are risk-generating some social cost which offset marginal benefits to take into account full cost of activities (Stone, 1992). Therefore, government intervention becomes necessary when it comes to the control of the problems of externalities. These interventions may come in the form of pollution abatement

technologies, subsidies, taxes, bans and fines (Tietenberg & Lewis, 2014). For instance, some countries have laws that protect the environment by limiting the release of local and regional air pollutant which is termed as internalizing externalities in economics. For some governments, it is now a priority to define economic policies that are appropriate to contain environmental degradation and consequently improving the quality of the environment (Liu, 2011; Rignot, et al., 2011).

Some market-based approaches to regulating emissions of greenhouse gases include tradable permits programs which set specific targets or cap on total emissions and auction required number of pollutions permits to polluters who are supposed to meet that goal. Emission taxes as a market-based also is a situation where tax-based controlling systems serve as incentives for polluters to seek cost effective solutions to control emissions (EPA-US, 2010). In the context of global climate change, there's a prescription for carbon pricing. That is, economists prefer the use of price interventions to correct market failures including those emerging from externalities. The preference of price intervention is because market efficiency requires the equation of private and social returns to which this approach ensures. Thus, the presence of externality only indicates the presence of a gap between the two which a price can remove the gap and restore efficiency (Stocker, et al., 2013; Stiglitz, 2013; Millar, et al., 2016; Van der Ploeg, 2018; Dietz & Venmans, 2019). The linkage between competition and optimality is crippled by externalities however, the issue of Pigouvian taxes is consistent with a decentralized price mechanism (Feldman & Serrano, 2006). The negative externality as a result of pollution is internalized in a competitive market by the introduction of a tax equal to the marginal damage that the environmental degradation causes (Pigou, 1924). Hence, placing per-unit tax on the production and consumption of goods that produce negative external effects in order to reduce greenhouse gases in the context of climate change.

Again, Coase (1969) indicates that in cases where there is a well-defined property rights and transaction costs are zero, intervention of the state may not be necessary. Individuals may negotiate their way through the resolution of the environmental problem. That is, in a situation where the number of decision makers involved is small, voluntary bargaining process and compensatory payments by the affected due to the externality may provide an optimal result. This means that, the agent affected by the externality may compensate the causer of the

externality to desist from or cease production activities or at least a reduce the damage to an optimal level. Market-based approaches have the advantage of achieving specific emission targets at lower social costs. It is worth noting also that, without a collective action by various countries across the globe, individual actions by countries may cause insignificant changes in the pollution of the environment. This has led to climate change conferences with the aim of creating the awareness of the phenomenon and making decisions about the emission of greenhouse gases. The Paris Agreement adopted in 2015 by 175 parties for instance aims at limiting global warming to well below 2⁰C compared to pre-industrial levels (UNFCCC, 2015).

Though efforts have been made to tackle global warming, per contra, the period 2010-2020 has been the planet's hottest decade and the long-term trend is upward (Hochrainer-Stigler, et al., 2020). Without conscious reasoning, climate change has been a long-term global problem whose marginal impact is more relevant from the policy perspective. Sea level rise as a result of climate change could not be left out as its impacts does not go unnoticed. Scientists have continuously monitored sea level rise as a change in the mean level of the sea deemed to posture threat to coastal zones characterized by low elevation (Taguam & Quiambo-Marquez, 2016). The ocean thermal expansion that increases the existing water volume as well as glacial melt from the Greenland and Antarctica which also add water to the oceans are the main factors that are accountable for the rise in sea levels (Hoegh-Guldberg, et al., 2018). That is, hereabouts two thirds of sea level rise globally is due to meltwater from glaciers and icesheets thus, the vast ice expanses which cover Antarctica and Greenland. Mostly, the ice loss in the Greenland emanates from warming air temperatures melting the surface of the ice sheet and calving from the glaciers which empty into the sea. However, in Antarctica, the freezing temperatures all year round that suggest that the interior ice sheet surface's does not melt but rather that there's ice lost as warmer temperatures join warm air temperatures to gradually erode at the shelves of the floating ice at the ends of glaciers in West Antarctica (Forrey & Gray, 2021). In consequence, the glaciers speed up and then more ice flow and melt into the sea. The global sea levels soared from 1.4mmyr⁻¹ over the period 1901-1990 to 2.1mmyr⁻¹ over the period 1970-2015 to 3.2mmyr⁻¹ over the period 1993-2015 to 3.6mmyr⁻¹ over the period 2006-2015 with a high confidence that the rise in GMSL (Global Mean Sea Level Rise) since 1970 is dominated by anthropogenic forces (Bamber, et al., 2019). The mean sea level of a given position is defined as the height of the surface averaged over a period of time as a month, a year or long enough such that fluctuations

that may be caused by waves and tides are removed (Solomon, et al., 2007) and mean sea level averaged over the global oceans is referred to as GMSL (Mimura, 2013).

As global sea level rises, the action of waves at higher elevations enhances the likelihood of coastal erosion and already, coastal erosion is causing about \$500 million per year for coastal property loss (Coastal Erosion | U.S. Climate Resilience Toolkit, 2021). Suffice to say that, sea level rise facilitates coastal erosion by bringing wave actions to progressively higher levels and permitting larger waves to reach the coast through deepening near-shore waters (Bird, 1996). The damaging impacts created by sea level rise on coastal areas vary depending on the geomorphological features, climate, ecological features and socio-economic as well as land use characteristics (Bosello, et al., 2021). About 44% of the world's population live in the coastal areas within 150km of the sea. The world's coastal area corresponds to 20% of the total available land (Burke, et al., 2001) and beckons migration destination for people. The coastal zone again vaunts a faster population growth than inland settings (United Nations, Department of Economic and social Affairs (UNDESA, 2015), Population Division) due to its livelihood opportunities (Watson, et al., 1996). Nonetheless, coastal areas with low elevation are liable to a more impacting consequences of sea level rise with harsh socio-economic implications (Stocker, et al., 2013).

The consequence of sea level rise is why the Inter-Governmental Panel of Climate change (IPCC, 2018) calls attention to the serious risk of sea level rise to particularly low-lying coastal areas. Climate change and sea level rise have soared the vulnerabilities of shorefront communities to coastal hazards such that in April and September 2016, extreme tidal events resulted in damages to both private and public infrastructure in Ghana. The storms washed the coast destroying homes and fishing equipment such as net, boats and outboard motors (Agbogah, 2016). The disturbing news is that various studies consent to the fact that global GMSL will keep on rising in the 21st century. For instance, the National Oceanic and Atmospheric Administration (NOAA, 2019) has projected that the global mean of sea level would rise at least one foot (0.3 meters) by the end of the century (2100) above 2000 levels. Again, the (Allen, et al., 2019) also reports that the global mean sea level will rise between 1.41 feet (0.43m) (0.29-0.59m, likely range; RCP2.6) and 2.76 feet (0.84m) (0.61-1.10m, likely range; RCP8.5) by 2100. All these projections imply that the problems that are already being faced by coastal areas including

livelihood problems are going to worsen in the coming years. If sufficiently great adaptation measures are not employed (Neumann, et al., 2015), there would be inconveniencing increase in flooding (Karegar, et al., 2017), exposure to hurricanes (Passeri, et al., 2018), displacement of millions of people (Hauer et al, 2016) and billions of dollars reduction of Gross Domestic Product (GDP) (Hsiang, et al., 2017). Also, global warming would make the average person feel as if she has lost 1.3% of income (Tol, 2019).

Narrowing the projected damages down to Ghana, studies including Addo, et al., (2011) have confirmed that Ghana has the potential of being inundated to about 202m by 2100 with 1970-1990 as baseline. Already, in Ghana a total land area of 231,730sqkm is being impacted by SLR (WSLR, 2019) which is liable to increase. Though the government of Ghana, communities and individual alike have adopted measures to reduce climate change impacts, these measures have rather been reactionary and more costly and not targeted to increase resilience (NCCAS, 2012). Adopting proactive and targeted approach would be more effective. Also, since Sea level rise is happening now and has a range of potential impacts putting livelihoods in coastal regions at risk, appropriate measures including climate mitigation (global response) and or adaptation (local response) are necessary. A synthesis of the two approaches is appropriate for effectively dealing with the problem of sea level rise (Nicholls, 2011) thus, promoting both measures simultaneously is important to address the threats. Adaptation measures protect, accommodate or retreat and they are meant to significantly reduce impacts while mitigation measures are targeted at reducing the emission of greenhouse gases that cause the increase in temperature. Africa is among the most variable in terms of climate on seasonal and decadal times series (UNFCCC, 2006) but they are limited in both human and physical capitals together with poor infrastructure to adapt to these changes (Assan & Kumar, 2009). The changes that occur in the local sea level may be differ from the global change (Mimura, 2013) however, in this study, sea level changes (rise) may be referred to the mean sea level changes as well as both the local and global sea level change.

Research Questions

The fundamental question that the research raises is: what are the economic impacts of sea level rise on coastal livelihood in Ghana?

To help in answering this research question, the sub-questions below are very crucial and unavoidable

What are the perceptions and coping capabilities of coastal dwellers on the phenomena of sea level rise?

What is the cost of sea level rise to coastal livelihood?

Does the effect of sea level rise influence vulnerability to poverty?

Objectives of the Study

The principal objective of this research is to assess the economic impact of sea level rise on coastal livelihood

To achieve this principal objective, the following specific objectives would be explored:

Examine the perceptions and coping capabilities of coastal dwellers on sea level rise.

Assess the cost of sea level rise to coastal livelihood.

Estimate the vulnerability to poverty as a result of sea level rise.

Hypothesis

Coastal dwellers perceive that on sea level is rising given the past and present damages and are able cope.

Sea level rise places costs on coastal livelihood.

Sea level rise enhances vulnerability to poverty of coastal dwellers.

Contribution of the dissertation

For decades now climate change is being observed with its wide spread consequences going unnoticed. The change in climate has affected people around the world in diverse ways. Some of the changes attributed to climate change include; sea level rise, changes in precipitation, drought, ocean acidification, the increased frequency and intensity of extreme weather events as well as floods and storms (Zachariadis, 2016). Quite a number of studies have been done on the impact of sea level rise across the globe (Leatherman, 2001; Fu, et al., 2016; Cui, et al., 2018) and a few within Ghana (Addo, et al., 2011; Boateng, 2012; Addo & Adeyemi, 2013) however, studies based in Ghana focus mainly on physical and ecological impacts neglecting the economic impacts. Therefore, in the measurement of damages, the quantitative aspect is lacking. Most

studies on the sea level rise and coastal areas in Ghana including (Addo, et al., 2011; Boateng, 2012) resort to the use of Geographical Information Mapping and Remote Sensing when reporting about sea level rise and vulnerability which gives a pictorial view that may not be exhaustive enough, making it difficult for policy makers to translate the findings into actions. Thus, it remains needful to also get the quantitative aspect as well to the value of the damages that sea level rise causes to cater to some of the deficiencies of the pictorial findings. This study employs mixed approach of qualitative and quantitative in establishing the relationship of household risk perception, damages and vulnerability.

Also, in situations across the globe where economic costs are considered, (Bosello, et al., 2007; Jevrejeva, et al., 2018; Schinko, et al., 2020) focus on the future economic impact if adaptation is not considered under different climate change scenarios rather than the current economic damages on which this research differs. Moreso, a large body of studies; (Nicholls, et al., 1999; Nicholls & Tol, 2006; Anthoff, et al., 2010; Hinkel, et al., 2010; Hinkel, et al., 2014; Spencer, et al., 2016) have sought to estimate and predict future damages by simulation models and not the consequences of past and current sea level rise. Additionally, earlier studies focused on estimating the direct impacts of sea level rise neglecting indirect impacts which have been argued as insufficient (Fu, et al., 2016). For instance, losing a building as a result of sea level rise is a direct impact however, the values of the services provided by the building or the revenue the building provides is an indirect loss which needs to be included.

Furthermore, this study by a way of filling literature gap moves a step further in methodology to measure the extent damages due to sea level rise by using the “willingness to pay” approach which is lacking in literature. This is another way to evaluate the extent of damages that sea level rise put on coastal dwellers and their potential and capacity to adapt or to relocate to find other sources of livelihood. Moreover, in the issues of adaptation, studies are basically reacting to particular events however, there is the need to building adaptation measures that are proactive and comprehensive. All the actual studies that suggest adaptation policies for the issues of sea level rise look to the government to work on the suggested policies. Nevertheless, joint action by both the public and the private sector are needed to efficiently adapt to climate change for coastal areas (Mendelsohn, 2006) which this study tries to emphasize by looking at how flood insurances on the part of victims may be helpful. Lastly, this study like all the other previous

ones seeks to contribute to existing knowledge for future use by attempting to fill the gaps identified above.

Plan Activities

The organization of this thesis is in 3 essays. The first essay covers the first objective that is; examining the perception and adaptation capacities of coastal dwellers on sea level rise. This essay aims generally at finding and contributing to the knowledge and understanding of the general public especially the coastal dwellers about sea level rise. Their attitudes and perception about the subject matter (climate change associated sea level rise and livelihood) obviously influence the responses and decisions. The next essay also looks at the second objective which is; assessing the cost of sea level to coastal dwellers. The goal of this section also is to find out the extent to which people in the coastal area are affected by sea level rise in terms of monetary value. The Willingness to pay approach is employed to measure the extent of damages in livelihoods. Then the last essay focuses on vulnerability to poverty as a result of sea level rise which is the third objective of the study. The intent of this essay is to find out how sea level rise may enhance vulnerability to poverty of the coastal zone and possibly suggesting measures to build resilience in the light of vulnerability to poverty.

ESSAY 1: Examining the perception and coping capabilities of coastal dwellers in the face of sea level rise.

1.1. Introduction

Damages to coastal zones emanating from sea level rise is one of the major projected economics damages from climate change, a key addendum to decisions on climate change and climate policies (Diaz, 2016). The coastal areas are among the most productive part of the earth which attract and concentrate humans (Jiménez, et al., 2017). These areas constitute habitats for a considerable size and growing population with much of these areas located in economic centers such as Tokyo, London, New York, Mumbai and Lagos among others (Nicholls, 2011). Despite these benefits, coastal areas remain one of the key sectors being threatened by climate change (Anthoff, et al., 2010; Nicholls & Kebede, 2012; Diaz, 2016). Sea level rise is liable to affect a mass of people in low-lying coastal areas through the destruction of infrastructure, capital assets, ecosystem and islands (Wong, et al., 2014) which are sources of livelihood for people. The impact that sea level rise has on coastal areas largely depends on their vulnerabilities while vulnerability is a function of the entity's exposure and sensitivity to environmental change together with its adaptive capacity (Parry, et al., 2007). The vulnerability of the coastal zones to such phenomena as sea level rise should be an important concern because livelihood of dwellers is being threatened.

Generally, Africa is the most vulnerable in the issues of climate change because of its already existing stresses such as poverty, conflicts, food insecurity among others coupled with low adaptive capacities (EPA-US, 2010). As coastal cities, especially those of developing countries grow in population and gain more economic relevance, exposure to climate change impacts including sea level rise is expected to increase (Hanson, et al., 2011). The (IPCC, 2014) reports that global sea level rise would erode shorelines in various coastal cities in Africa (Field, et al., 2014). There are studies including (Kulp & Strauss, 2019; Oppenheimer & Glavovic, 2019), that project an increase in global sea levels thus, livelihood of coastal regions will be overwhelmed with these prevised sea level rise projections (Saha, 2009). Adaptation needs will be increased along low-lying coast worldwide. Nonetheless, whether or not and how well issues of climate change will be tackled also depends on the general public's understanding and perception of the subject matter. For climate change adaptation, the processes involved are the perception of the change in climate and then taking a decision whether to adapt or not (Maddison, 2007). The

process of reception of information and stimuli from the surroundings and converting them into psychological responsiveness is what is termed as perception according to (PER, 2000). In policy decision making, the attitudes of the public play a very crucial role (Slaymaker, 1999; Perry, et al., 2001).

Therefore, having an understanding of publics' perceptions about the environmental issues and why they have those views is essential to developing sound public policies and also gaining acceptance for such policies (Burger, et al., 2016). The global risk of sea level rise as a result climate change although has been known for decades (Barth & Titus, 1984), acknowledgement by the public and associated policy response are lagging (Hulme, 2009). Studies have pointed out that there is a fall-off in the interest of climate change and people are less concerned about climate change than previously (Ratter, et al., 2012; Gallup Organization (GO) Environment, 2013). Some of the reasons scholars have attributed to the resistance to warnings of climate change include; political polarization (McCright & Dunlap, 2010; Kahan, et al., 2012; Guber, 2013), errors of individual cognitive (Serman, 2008), psychological barriers (Newell & Pitman, 2010; Swim, et al., 2011), ethics challenges (Markowitz & Shariff, 2012), discourses of fear (Hulme, 2008), media impact (Antilla, 2010; Carvalho, 2010; Sonnett, 2010; Schuldt & Roh, 2014) and ineffective communication (Moser & Dilling, 2004; Moser, 2010; Moser & Ekstrom, 2010; Spence & Pidgeon, 2010; Kahan, 2013). Various studies cited above have contributed their quota of knowledge sharing in the impacts of climate variability and sea level to coastal zones. Nonetheless, the objective of this study is to examine the perceptions of coastal dwellers on sea level rise and their coping capabilities.

Objectives of the Essay

The principal objective of the study is to examine the perceptions and the coping capabilities of coastal dwellers on sea level rise as well as their coping capabilities.

To help achieve this principal objective, the following specific objectives would be explored:

Investigate the factors that affect the knowledge of sea level rise.

Investigate the determinants of the knowledge of climate change as the cause of sea level rise.

Assess the factors that affect the ability to cope with sea level rise.

Plan Activities

This Essay seeks to analyze the perception and coping capabilities of coastal dwellers to sea level rise. Specifically, the study seeks to Investigate the factors that affect the knowledge of sea level rise. Again, the study Investigates the determinants of the knowledge of climate change as the cause of sea level rise. The organization of this essay is in 5 sections. The first section covers the introduction to the essay, the objectives of the essay, the plan activities of the essay as well as some stylized facts. The second section explores related literature to the essay. The Literature review is basically in two parts. The first part (Theoretical Literature) talks about existing theories concerning the subject matter. The second part of the literature review also is the Empirical literature. Here, related studies of the subject matter are explored. The literature review section helps guide in using the best theory and methods for the study as well as identifying the gaps in previous studies in order to explore those gaps. The third section is the methodology section. This section also highlights on the case study area of the study, the variables considered for the study as well as the theoretical and empirical methods used for the research. Moving forward, section four analyzes the findings from the empirical methods. This section presents the results and discusses them as well. Finally, section 5 presents the conclusion of the essay based on the results and discussions as well as making recommendations.

1.1.1. Stylized Facts

Sea level rise as a result of climate change pose serious threats to countries who have high population and great economic activity concentration in their coastal regions (Dasgupta, et al., 2009). The rise in sea level may not be uniform in all regions yet, one cannot overlook the fact that the phenomenon is having significant impacts on both coastal and island regions where a number of the world's population live (Anthoff, et al., 2006). The consequences of sea level rise include flooding and increased intensity of storm surges which cause damages to coastal areas thus, posing serious threats to coastal living across the globe (National Geographic Society, 2019). Loss of land is already advancing (Mentaschi, et al., 2018). It is projected that 1 billion people who live in low elevation coastal zone (less than 10m above the high tide line) will be experiencing coastal flooding due to SLR and storm surges (Kulp & Strauss, 2019). In all these, understanding of the phenomenon of climate change as well as the perception of people about it

shouldn't be left out. Public risk perception of sea level rise could possibly affect their support for mitigation policies (Jennings & Courtney, 2016). A key to getting support from the public and to foster collective action for effective adaptation and mitigation policies is understanding the perception of the public about climate change (Leiserowitz, et al., 2021; Taylor, et al., 2014; Kitolelei & Sato, 2016). Those who believe that climate change to be anthropogenic and also in scientific consensus have the tendency to perceive sea level rise in the future (Shao, et al., 2020). In addition, people who perceive SLR as a distant hazard may have some reluctance in receiving information about it (Retchless, 2018). There have been so many evidences of global warming yet, most Americans are doubtful about the general rise in the temperature of the earth and even about 32% deny the fact that climate change is anthropogenic (Leiserowitz, et al., 2018). In order to improve public awareness and understanding of risks and responses to SLR, there is the need to draw on local, indigenous, scientific knowledge systems along with social learning regarding locality-specific SLR risk and potential response (Oppenheimer, et al., 2019).

Until recently, researches and negotiations on climate change have focus extensively on the reduction of greenhouse gases which obviously haven't been very effective especially in dealing with the effects of climate change. Focusing also on adaptation to some of the aftermath of climate change is very crucial and are recently joining those of mitigation at the center of policy debates. Adaptation refers to changes in response to altered circumstances to improve conditions of life or survival (Oliver- Smith, 2009). Being helpless amidst the risk of SLR, people have learnt to cope with it by building structures against storm floods over time. Hard coastal protection measures in the forms of dikes, sea walls embankments and surge barriers are extensive. In Europe, East Asia and around number of coast cities and deltas, these hard coastal protection measures provide some safety (Oppenheimer, et al., 2019). Assets and human settlements are protected by hard coastal defense structures. In the US, about 14% of its coastline is being protected by hard structures (Gittman, et al., 2015), 7% of the Indian coast is being protected by seawalls with another 7% under construction (CSIR, 2020). Mainland China has 60% of its coastline hardened (Luo, et al., 2015). Again, buildings have been made on silts to allow water flow freely underneath in some countries and the same time, houses have been built on man-made earthen hills in other places (World Ocean Review, 2017). Furthermore, Ecosystem-based adaption strategy which exploits nature-based solutions and ecosystem services are also considered. As such, UN Environment Program (UNEP) supports beyond 45 ecosystem-

based adaptation projects aiming to restore about 113,000 hectares of ecosystems while benefitting around 2.5 million people across the globe (UNEP, 2021). However, the incorporation of flexibility in coastal protection designs has been called for. An adaptive pathways approach is being promoted as uncertainty lingers around the extent of rise of sea levels (World Ocean Review, 2017). The adaptive pathways approach involves planning coastal protection measures adapted to short term consequences of change, not committed rigidly to uncertain assessment scenario to the end of the century (World Ocean Review, 2017).

1.2. Literature Review

In the 21st century, SLR poses great risk to residents of the coastal region (Shao, et al., 2020). It could displace millions of people by 2100 (Bamber, et al., 2019). Sea Level rise as a result of climate change is a global threat and the evidences from scientific researches are overwhelming. Until recently, typical SLR rise predicted a 0-1m rise in the 21st century (Church *et al.*, 2001; Houghton *et al.*, 2001). However, new data on the rates of deglaciation in Greenland and Antarctica show greater significance in melting of glacial hence a possible revision on the SLR in this century (Dasgupta *et al.*, 2009). Science experts tend to be analytical in their processes of evaluating risk while the lay people tend to use their experiences in perceiving risks (Marx, et al., 2007; Weber, 2006). Climate change as a complex issue transcends personal experiences both in temporal and spatial senses (Shao, et al., 2020). How the phenomenon of SLR is perceived, influences adaptation measures. Some commonly held beliefs may be a great hurdle to the implementation of policies and effective planning of coastal regions (Ryan, et al., 2011). The inconsistency between risk assessments from experts and risk perception of lay people have long been studied (Slovic, 1987). The public's understanding of sea level rise is relatively unexplored (Priestley, et al., 2021). The future of global progression of sea level rise is uncertain while a more advanced than the global average is expected in some areas (World Ocean Review) adaptation is key. This section reviews some theoretical literature and conceptual framework as well as empirical studies.

1.2.1. Theoretical Literature

There has been a growing literature about the vulnerability of the natural environment to the events of global climate change. Since the 19th century, scientists have been cognizant of the

increase in CO₂ and other greenhouse gases in the atmosphere and their impacts. The issue of global climate caused by the accumulation of greenhouse gases have raised concerns from all over the globe and the concept has been widely understood scientifically as an already happening phenomenon which countries are experiencing its effects. Sea level Rise is one of the major consequences of climate change which affect people in the coastal areas and threatens to increase in the future. In order to find solution to these impacts being caused by climate change, there is the need to analyze the perception as well as coping mechanisms of coastal dwellers who are affected the most. Thus, this section reviews theories that already exist about the perception of sea level rise as well as the coping mechanisms.

Since 1800, sea levels have increased substantially and are expected to rise more as a result of climate change (Solomon, et al., 2007; Church, et al., 2010). There has been various consensus about the amount of rise in the sea levels with 2050 and 2100 projections based on different mitigation measures to reduce the emission of GHGs (Priestley, et al., 2021). Risks from SLR and associated storms surges and erosion related to buildings, infrastructure and livelihoods are expected to increase measurably. (Harvey & Caton, 2003; Mcgranahan, et al., 2007; Haas, et al., 2009). Despite the strong scientific evidences of the reality of climate change induced SLR, there is lack of public understanding of it (Taherkhani, et al., 2020). The public feel not well informed enough about sea level rise hence find it difficult to understand its issues (Covi & Kain, 2016; Thomas, et al., 2015). Polarized views on sea level rise have influences on policy options (Ryan, et al., 2011). Studies on perception of climate change risk confirm that scientific understanding does not all the time engender much more public concern (Leiserowitz, 2005). Personal beliefs and values, demographic factors such as; race, gender and age, political views, affiliation, trust, (Slovic, 1999), outrage or emotional factors including: fairness, voluntariness, morality of hazards and familiarity (Sandman, 1987), discomfort with uncertainty (Aven & Renn, 2009) together with complex risk interactions, values, personal experiences and the social contexts in which these are experienced (Kasperson & Kasperson, 1996; Cutter, et al., 2000; Adger, et al., 2009; Renn, 2010) are some of the defining factors of risk perception.

Thus, understanding the beliefs and responses of coastal communities to risks posed by SLR as they become increasingly affected is necessary. Some coastal management team believe the inclusion of public perceptions in policy decisions is a step in the right direction (Thomas, 2013).

According to Fiorino (1990), there could be at least three reasons to support the inclusion of public perception in policy decisions. These reasons are normative, substantive and instrumental. For normative, disregarding the perspective of the public is undemocratic and again, people are the best judge of their interest (Fiorino, 1990, p. 227). The substantive reasoning infers that, the judgements of the public are sound comparatively than that of the experts. The public are able to notice the misses of experts. Further, the instrumental reason is that, effective participation by the lay enhances legitimacy, a better decision making as well as incorporating wider range of values while reducing the probability of error (Fiorino, 1990). With all these supports for the inclusion of public perception, there are some commentators who on the contrary believe risk perception is not needed for policy decisions. The argument for this stems from the fact that public perception may not be scientific based hence may introduce bias and noise at the peril of lives and resources (Pidgeon & Beattie, 1998).

A number of frameworks have evolved in connection with the exploring of risk perception. These include, the psychometric paradigm, cultural theory, and social amplification of risks. The psychometric paradigm involves the use of psychometric scaling methods to quantify and rate characteristics of qualitative nature (Fischhoff, et al., 1978). The cultural theory includes more social and factors in risk perception. A more modified form of the cultural theory is the cultural cognition of risk where both psychometric paradigm and cultural theory are considered in describing the perception of risk coherent with self-defining values (Kaha, et al., 2006). The psychometric furnishes an account of the individual level analysis by cultural values shape risk perception (Kahan, et al., 2011, p. 2). Lastly, the social amplification of risk method like the cultural recognition method attempts to combine the psychometric and cultural theories of risks (Pidgeon & Beattie, 1998). Here, there is a systematic linking of technical assessment of risk with psychological, sociological, and cultural perspectives of risk perception and risk-related behavior (Kasperson, et al., 1988, p. 177). This method examines how more objective risk characteristics could be amplified or dampened by psychological processes and interactions between actors (Thomas, 2013). Social amplification of risk approach places much emphasis on qualitative methods thus, able to grab the complexness of risk perceptions in specific hazard environment (Pidgeon, et al., 2006, p. 103).

Vast Islands, coasts and communities face enormous risks from coastal hazards including SLR in the absence of adaptation irrespective of their level of development and whether they are urban or rural. Developing appropriate responses to social impacts of sea level rise require that these impacts be addressed at the multiple levels where they exist and particularly in the complex interrelationships between nature and society (Oliver- Smith, 2009). According to Oppenheimer (2019), SLR can be approached in 5 different major ways which include hard coastal protection, Advance, Ecosystem-based adaptation (EbA), Accommodation and Retreat. Hard coastal protection minimizes risks and impacts by blocking the inland propagation of mean or extreme SLR effects. Hard protection may be economically efficient but could lead to increased exposure in the long term. The advance adaptation method creates new land by building seawards such as new land reclamation above sea level or planting of vegetation with the specific intent of supporting natural accretion of land. The EbA approach also deals with conserving and restoring the eco-system including reefs and coastal vegetation. Often, the EbA, while protecting vulnerable communities provide ecological benefits that enhance the well-being of humans as well (UNEP, 2021). In addition, the accommodation strategy comprises varied set of biophysical and institutional responses to bring down coastal residents' vulnerability, human activities and the build environment. And finally, the retreat method deals with the moving of people, assets and human activities from exposed areas in order to decrease their exposure.

1.2.2. Empirical Literature

The coastal regions serve as homes for a large population and remain economically productive regions across the globe. As such, the threat of sea level rise emanating from climate change to the coastal areas have had so many studies in to it for decades (Diaz, 2016). One of the major environmental concerns today is climate change associated with sea level rise (Ali & Syfullah, 2017). Without proper management of SLR risk, the coastal people face an increasing risk of flooding and damages to buildings (Covi & Kain, 2016). For risk communication to effective, more than sending out factual information is required (Fischhoff, 1995). Effective communication requires that the information being given out raises awareness, enhances understanding and be able to move audiences to action as well (Boholm, 2009). Such information involves the recognition of the at-risk population's perceptions, issues and attitudes in order that decisions could be made of best available information (Leiss, 1996; NRC, 2009). The various studies cut across the perception of sea level rise to adaptation to the damages

associated to sea level rise at the international levels, regional levels, national levels as well as local levels.

1.2.1a. Empirical Literature on Perception of Climate Change and Sea Level Rise

Linnekamp et al, (2011) examined household perception of flooding in Paramaribo and Georgetown in the Caribbean. The study indicated an increasing exposure of households to floods with lower income groups experiencing longer from the exposure coupled with more damaging effects. Also, lower-income areas take more measures to avert flooding than compared to higher income earning households. Additionally, the results infer that there's lack of city-wide organizations and participative measures for households with potential damaging effects on lower income households.

Thomas (2013) compared the expert and public perception of sea level change on the Severn Estuary using mental models approach. The methodology which is three-phased including; investigating expert perceptions through Semi-structured interviews, probability elicitations and cognitive mapping, investigating public perception by mental models interview and exploring opinions of the public living around Severn Estuary. The perceptions from both the experts and public were then compared and contrasted. A grounded approach is employed to explore themes coming up from expert and public qualitative interviews with regression analyses exploring the relationships between themes explored in the quantitative public survey. The results show areas where public understanding of SLR is consistent with experts understanding. The public think that sea levels will rise which will lead to increased flooding and damage of property. However, the people of the Severn Estuary feel less informed about sea level change.

The susceptibility of Philippines to coastal hazards being exacerbated by climate change led Combest-Friedman (2012) to investigating households' perception of coastal hazards and climate change. Data from meteorological department and structured interviews were analyzed with SPSS following a logistic regression analysis. The assessment of the meteorological data and local perception indicated that perceived coastal risk is affected by spatial location and resource dependency rather than socio-economic conditions.

Using a document-based evaluation method, Covi and Kain (2016) worked on SLR risk communication. The aim of the study was to infer the response of vulnerable coastal areas residents to SLR risk communications and also to ascertain if communications localized for

specific population improve reception. The results showed how participants find it difficult to understand information communicated. Also, SLR were perceived to be temporally and spatially distant hence making it challenging for communicators to communicate the urgency of the problem.

Also, Taguiam & Quiambo-Marquez (2016) assessed the perception of sea level rise employing a social survey of 254 households in five communities from Quezon Province in Philippines. Following the quintet type of scale, 12 SLR related statements were framed and answered by the respondents (households). Then, scores obtained from the 12 statements went through factor analysis. The results from the factor analysis revealed three dimensions that SLR is perceived. Thus, SLR is affecting social wellbeing of households, changing the coastal environment seascape and causing displacements of households.

Perez & Egan (2016) presents a study on experience and perception of sea level rise, flooding, legacy pollution and health in an environmental justice (EJ) community in Northern Delaware. The study made use of quantitative surveys at local events to measure knowledge and concern for SLR, flooding, legacy pollution and health. Again, focal groups were created to enable a more extensive understanding of survey results. Also, community perceptions were examined relative to existing policy documents and maps on SLR inundation of affected sites. The study using this mixed approach found out that longtime familiarity with flooding issues might explain the lack of knowledge of SLR. Furthermore, the value of experiential knowledge of local flooding could enhance the effectiveness of future policy formats.

Uddin, et al., (2017) studied the determinants of farmers' perception of climate change in the coastal region of Bangladesh examining the description of the socio-economic characteristics of farmers, reporting on the perception of farmers' experiences with climate change and the identification of the socio-economic factors that are associated with the perception of farmers of climate change. The study utilized a logit model, weighted indexes and descriptive statistics to analyze the result of a sample farmers' responses on the proposed questionnaire. It was found that, majority of the farmers, about 88% perceived a change in climatic conditions.

Stojanov, et al., (2017) studied local perceptions of climate change impacts and migration patterns in Male, Maldives. The study set out to find out islanders' perception about climate variability and whether out-migration from the island could be considered as an adaptation

strategy. Based on both quantitative and qualitative analyses, the study found out that respondents perceive climate change impacts such as sea level rise as being one of the key factors affecting livelihoods and the Maldives society as a whole. Respondents also perceive the challenges from sea level rise to be enormous at the national level in the near future thus migrating out of the island to other countries would be the potential option.

Rakib, et al., (2019) also investigated the situational factors affecting the consequences and social activities. They went on further to consider the effectiveness of traditional knowledge in reducing possible risk. Both qualitative and quantitative methods were utilized in analyzing the various parameters. The results showed that long-term and repeated actions of climatic hazards severely affect most livelihood sectors.

Shao et al., (2020), compared the public perceptions of sea level rise with scientific projections across five states of the U.S. Gulf Coast region. The study adopted an integrated approach merging 2019 survey data with contextual data including the percentage of the population who lived within the Special Flood Hazard Area (SFHA) and social vulnerability at the country level. The results of the study depict that, public risk perceptions of sea level change are influenced by political predisposition. That is, republicans are less likely to expect sea level rise in the future than the Democrats. Again, sea level rise is a temporal distant issue among the case study area. Moreover, those that have experienced faster SLR in the past are more optimistic about the future and they underestimate the magnitude of SLR in the future as compared to those experiencing SLR at a slower rate.

In addition, Montero & Batista, (2020) set to determine the level of social perception of coastal risk (SPCR) of the population facing hurricanes in Cuba's southeastern region. Non-structured interviews were carried and the results showed medium and low levels of SPCR in the population studied thus concluding with the proposal to consider some actions of coastal protection in the Plan to Face Climate Change in the Republic of Cuba.

Priestley (2021) investigated the public's understanding of the amount, rate and causes of climate change induced sea level rise among a representative sample of New Zealand adults. The findings of the study suggest the tendency of the respondents to overestimate the scientifically plausible amount of rise in sea level.

Alcantara et al., (2022) examined the perceptions of coastal communities on climate change as a threat, a driver of SLR and a factor which affects coral reefs and seagrass beds. A face-to-face survey was conducted among Taytay, Aborlan and Puerto Princesa coastal areas in Palawan, of Philippines. The results shows that most respondents perceived climate change to be happening. The majority believe that climate change is a threat to coastal marine environment. Respondents perceive SLR to be the cause of coastal erosion however they believed mangroves can prevent coastal erosion. Generally, perceptions of climate change were found to vary with household income, age group, education and geographical location.

1.2.2b. Empirical Literature on Coping Mechanisms

Linares (2012) examined a number of soft adaptation strategies including beach nourishment, dune restoration afforestation, reforestation and marine soft engineering. The advantages and disadvantages of the soft adaptation strategies were analyzed from an ecological and socio-economic perspective. The study concluded that, soft strategy options have positives outcomes and offer very applicable solution to coping with sea level rise.

Koerth et al., (2013) addresses the question of what motivates coastal households to be proactive in adapting to SLR and its associated flooding. The study made use of questionnaire survey to collect data in Germany and Denmark. Two elements based on variables of the Protection Motivation Theory were constructed. These elements depict perception of flood risk and household level adaptation. Additionally, individual and residence related characteristics were included. Descriptive statistical analysis, multiple regression analysis, and logistic regression analysis were utilized in realizing the objectives. The study concluded that the main explanatory variable adaptation behavior was personal experience while personal history and cognitive variables are also relevant.

Carro et al., (2018) worked on building capacity on EbA strategy to cope with extreme events and SLR on the Uruguayan coast. The goal of the study was to show a case study of EbA measures to increase the resilience of coast system to extreme weather events and SLR implemented. A participatory process which involved the community and institutional stakeholders was organized to choose and prioritize adaptation measures to bring down erosion. Soft measures of adaptation were utilized for the recovery of ecosystem. At the end of the study, municipal staff and stakeholders had undergone a capacity building, exchange of knowledge

with national-level decision makers and scientists as well as the incorporation of EbA strategies by substantial-level coastal government. This study also enhanced the introduction of innovations in the structure of the coastal management.

Navarro et al., (2021) studied coping strategies regarding coastal flooding risk in a context of climate change in a French Caribbean Island. A theoretical model of situational and dispositional factors underlining the strategies were proposed and empirically tested with 583 habitats in the Guadeloupe exposed to coastal flooding risks. The study finds that avoidance of coping is predicted by coastal flooding risk perception, place attachment and difficulties to regulate emotions. How perceived action efficiency predicted vigilant coping. Through the results of global sandy coastlines projection developed by Voudoukas, regional coastline retreat and coastal erosion were estimated. The mean sea-level rise projections show that regional estimates for coast of Mozambique are relatively higher than global estimates for all RCPs. However, there are differences in rise in sea levels by 2100 under different RCPs. The study thus proposes and discusses properly local responses for coping for the RCP4.5 and RCP8.5 scenarios through 2100. These local responses include retreat and EbA strategies.

The aim of Mucova et al., (2021) was to perform SLR projections in Mozambique while understanding its role and implications on the north coast. Through the analysis of model outputs supporting global estimates of the 5th IPCC report, SLR was estimated near the coast of Mozambique under each of the 4 RCP scenarios. The study concluded that, the tourism sector, settlements, ecosystems services, and local populations are likely to be affected by 2050, threats increasing by 2100 under the RCP4.5 and RCP8.5 scenarios. Thus, local responses for coping mechanisms were proposed and discussed.

Robert & Schleyer-Lindenmann (2021), assessed how seriously SLR, coastal risks and adaptation are addressed in spatial planning in the Provence-Alpes-Cote d'Azur region in southern France. The study concluded that there is still a long way to go as far as the subject matter is concerned. Also, local development strategies contradict the idea of adapting thus the need for local authorities and central government to take more collaborative approach.

Nguyen et al., (2022) worked on maximizing resilience to SLR in urban coastal ecosystems through systematic conservation planning in Singapore. The study aimed at coastal ecosystem's resilience to SLR and to explore how this resilience could be incorporated in conservation

planning along an urban shoreline. Resilience of coastal wetlands to SLR was modelled and integrated in conservation planning. The results indicated coastal habitats to SLR responses to vary across modelling periods. Though existing habitats will experience loss in coverage, there's a net gain in the extent of mangrove forests and tidal flats by the century's end as a result of potential habitat conversion. Coastlines that are highly modified with urbanization obstruct wetlands' ability of migrating landward thus, a major mechanism for habitats to cope with SLR.

Generally, the differences between this study and previous studies centers on mainly methodology and location. Though perceptions of climate change have been studied, there barely exist similar studies in West Africa and for that matter, Ghana. Climate change pose serious threats on the region because of its low capacity to adapt, lower education comparatively as well as poverty therefore the need to have a such research concentrating on the region. In terms of methodology, this study uses both descriptive statistics as well as econometric methods in analyzing the perception of SLR unlike most of the previous studies where either one of the methods may be utilized. This study also considers the perception in the form of knowledge of sea level rise, the knowledge of climate change as a cause of sea level rise where in most earlier studies it's just one component that may be looked at. Again, the study utilizes the rbiprobit regression method in analyzing the perception of sea level rise. The knowledge of sea level rise variable which is a dependent variable becomes an independent variable to the knowledge of climate change as the cause sea level rise variable. Usually, most studies would use either logistic regression or the probit regression method for primary data incase an econometric analysis is done. Also, in the descriptive analyses, the study considers genders, where the differences in gender as far as perception and coping mechanism are concerned are assessed. Furthermore, in terms of location (Ghana), to my best of knowledge, there hardly exist any research of the subject matter where economic theories and econometrics are used in analyzing the perception as well as the coping mechanism. This study therefore attempts to fill these gaps that have been identified.

1.3. Methodology

There have been debates about the consequences, and possible solutions of climate change as the impacts keep overwhelming. SLR as a consequence of climate change cannot be overlooked

especially when it endangers lives in the coastal areas through flooding, conversion of dry land into wet lands and increasing salinity of fresh water (IPCC, 2013). Relevant scientific studies exist and point out that climate change is anthropogenic yet the opinion of the general public and even other scientists is far from unanimity (Leiserowitz, et al., 2012; NW, et al., 2012; Cook, et al., 2013; Idso, 2014). SLR risk messages may fail in informing adequately the general public or even persuading them in responding to the consequences (Harvatt, et al., 2010) owing to the fact that this information may be too general for people to identify with, that is; too specialized scientific and technical information, and messages not being sufficiently tested with representative audiences to adjudge potential reactions (Covi & Kain, 2016). This section deals with analyzing the perception of people about sea level rise. By perception, the components involved include, the reactions and responses towards sea level rise, whether people are aware that sea level rise is happening, what people think is the cause of the sea level rise. By coping capabilities, the components are whether people can cope amidst sea level rise and whether they think it's temporal or not.

1.3.1. Econometric model setup

Recursive Bivariate Probit Model, Logistic Regression Model and Descriptive Statistics are used to analyze the responses from respondents. Perception is measured by a dummy variable in the model where a value of 1 is assigned to respondents who perceive a rise in sea levels and 0 for respondents who think otherwise.

The modeling method between two dependent binary variables commonly used is the Bivariate Probit Method. However, there are certain cases where one of the dependent variables becomes an endogenous regressor variable for the other dependent variable in which case Recursive Bivariate Probit regression is used. Thus, Recursive Bivariate Probit regression method is a method whereby two Probit equations whose errors are correlated, and one of the binary dependent variables becomes an endogenous regressor variable for the other dependent variable. Suppose we have a model from recursive bivariate probit regression as;

$$y_1^* = x' \beta + \alpha y_2 + \epsilon_1, y_1 = 1[y_1^* > 0] \quad (1)$$

$$y_2^* = z' \gamma + \epsilon_2, y_2 = 1[y_2^* > 0] \quad (2)$$

$$\text{With } \begin{pmatrix} \epsilon_1 \\ \epsilon_2 \end{pmatrix} \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right]$$

Where correlation between ϵ_1 and ϵ_2 induces endogeneity, x and z share some or all covariates. Also, according to Greene (2018), the endogenous nature of y_2 can be ignored and estimates are weakly identified if $x = z$ as in (Han and Lee 2019).

Again, a binary logistic regression model is selected to identify the significant variables that determine whether respondents are able to cope with the sea level rise or not. Logistic regression analysis is somehow similar to linear regression analysis except that the outcome in logistic regression is dichotomous that is; success or failure, yes or no, etc. Logistic regression analysis is popular among researchers widely used (Ranganathan, et al., 2017).

The functional form of the logit model is specified as;

$$P_i = E(Y = 1/X_i) = 1/1 + e^{-(B_0+Bix_i)} \quad (1)$$

Equation (1) is expressed simply as;

$$P_i = 1/1 + e^{-z} \quad (2)$$

Where P_i , is the probability of the households, the i^{th} respondent and ranges from 0 – 1. e^{-z} is the irrational number e raised to the power of Z_i and Z_i is the function of N-explanatory variables expressed as;

$$Z_i = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_nx_n + \mu_i \quad (3)$$

Here also, β_0 is the intercept, $\beta_1 \dots \beta_n$ are also the slopes of the equation in the model.

Prior to the estimation of the recursive bivariate probit regression and logistic regression the explanatory variables were checked for the presence of multicollinearity. The Variable Inflation Factors (VIF) was employed for the testing of multi-collinearity. In Ordinary Least Square regression analysis, there exist the problem of multicollinearity when there is a linear relationship between two or more independent variables thus, the VIF shows the severity of multicollinearity.

VIF can be calculated as; $VIF_i = \frac{1}{1-R_i^2} = \frac{1}{Tolerance}$ where R_i^2 is the unadjusted coefficient of determination for regressing the i^{th} independent variable on the remaining ones. The Tolerance is the reciprocal of VIF and either the Tolerance and the VIF can be used to detect

multicollinearity. Usually, a VIF above 4 or Tolerance below 0.25 shows the possibility of the presence of multi collinearity and hence needs to be investigated further.

1.3.2. The Study area

Armah & Amlalo, (1998) defined the coastal zone of Ghana as the area below 30m contour covering 6.5% of the 238,535km² land area and it is home for more than a quarter of the population of the country. According to the west Africa Coastal Areas (WACA) (2018) management program, coastal region of Ghana contributes to about 80% of the country's capture fish production annually. For the purpose of this study, four coastal towns in total were chosen from the Ketu South Municipal district and Keta Municipal district. These towns are; Adina, Amutinu and Selarkope from Ketu South Municipal and Kedzikope from the Keta Municipal respectively. The reason behind the choices of town is based on the recent tidal waves and sea coast flooding in these areas. From the Ghana News Agency, about 35 and 34 households in Adina and Amutinu respectively were affected by the tidal waves, that occurred on the dawn of November 8, 2021.

The Ketu South Municipality is one of the 18 administrative districts in the Volta Region of Ghana located at the south-eastern corner of Ghana with its capital being Denu. Ketu South is described as the eastern getaway to Ghana as well as being the only district sharing boundary with the capital of another country, Lomé in the republic of Togo. According to the 2010 Population and housing census, the municipal represents 7.3 percent of the Akasia total population of the Volta region and a little over half of the municipal's population being rural. Of the population aged 15 years and older, about 71% are economically active while about 22.9 are not. About 95.5% of the active population are employed with 4.5% not employed. Of the employed population of the Municipality, about 31% are engaged in craft and related trade works, about 28.2% engage in service and sales work while 17.3% are skilled agricultural, forestry and fishery workers.

Also, for the Keta Municipality, it is located to the Volta estuary, about 160km from Accra and shares common borders with Akatsi South District to the north, Ketu North and South District to the east, South Tongo District to the west and Gulf of Guinea to the south. The coastal strip is marked by sand bars along with sea cliffs bordering the coast. About approximately 64% of the population aged 15 years and older is active economically with approximately 36% not

economically active. About 93.5% of the economically active population are employed with about 6.5% not employed. Again, of the employed population, about 34.8% are engaged in skilled agricultural, forestry and fishery work, 21.8% involved in service and sales, 25.4% in craft and related trade and 2.3% are engaged as managers.

1.3.3. Structured Interview

Face to face interviews were conducted with households in flood prone coastal areas using structured questionnaires. Interviews were conducted at the household level where mainly household heads were interviewed and less cases other representatives of the household where household heads were not available. The idea of the household heads is the fact generally the household heads are the breadwinners of the family. The interview was random and any household could be interviewed as long as they are available. Two municipalities were chosen based on the recent coastal flooding in the country namely: Ketu South Municipal and Keta Municipal in the Volta Region of Ghana. The towns in which the survey was conducted includes: Adina, Selarkope, Amutinu (Ketu South Municipal) and Kedzikope (Keta Municipal) based on recent flooding. A sample of over 500 households were interviewed in total with the main focus on household heads from an overall population of about 1,469 based. The sample size is chosen based the formular; $\frac{N}{1+e^2} = \frac{N}{1+0.05^2}$ (Bartlett, et al., 2001) where N is the population and e is the margin of error. This formular is repeated for all communities involved in the study. The population data on households and household heads was taken from the Ghana statistical service (GSS) specifically from the office of the GSS in volta region of Ghana, Ho. The population data was based on 2010 population census of Ghana however, adjusted be a quasi-proxy for the population using the annual population growth rate of the volta Region. This is because the 2021 population and housing data was not yet available at the time of the survey. The survey design randomly targeted any households of the community could be utilized. After the survey, about 517 respondents had responded to the questionnaire although the study looked forward to about 565 respondents. Furthermore, the data was cleaned based on the responses which came to about 423 respondents. In all 423 respondents were used for the analysis.

1.3.4. Variables

Table 0.1. below presents the variables used in the estimation and analysis. All these variables were obtained through the survey questionnaire presented to respondents.

Table 1. Variable Description

Variables	Description
SLRKnow	Knowledge of sea level rise, Yes or No (Dummy =0 for No and 1 for Yes)
GenderD	The Gender of the respondent, Male or female (Dummy= 0 for Female and 1 for Male)
Edu2	The Education status of the respondent; formal education or not (Dummy= 0 for no formal education and 1 for formal education)
NewMaritalStatus	The marital status of the respondent, whether married or not (0 for single and 1 for Married)
workdays	The number of days in a week the respondent works
workhours	The number of hours in a day the respondent works
HHnum	The number of people in the household
Fishingactivities	Whether the respondent engages in fishing activities, Yes or No (Dummy= 0 for No and 1 for Yes)
Saltminingactivities	Whether the respondent engages in salt mining activities, Yes or No (Dummy= 0 for No and 1 for Yes)
Otherlivelih	Whether the respondent engages in other livelihood options other than Fishing activities and salt mining activities, Yes or No (dummy= 0 for No and 1 for yes)
SLRCope	Whether the respondent is able to cope with the rise in sea levels, Yes or No (Dummy= 0 for no and 1 for Yes)
SLREffect	Whether the respondent is affected by sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
SLRPropLoss	Whether the respondent has lost properties due to sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
SLRDisplace	Whether the respondent has been displaced due to sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
Income1	If the respondent earns annual income between Ghs100-----5,000, Yes or No (Dummy= 0 for No and 1 for Yes)
Income2	If the respondent earns annual income between Ghs5,000-----Ghs10,000 Yes or No (Dummy= 0 for No and 1 for Yes)
income3	If the respondent earns annual income above Ghs10,000 Yes or No (Dummy= 0 for No and 1 for Yes)
AdinaTown	If the respondent lives in Adina, Yes or No (Dummy= 0 for No and 1 for Yes)
AmutinuTown	If the respondent lives in Amutinu, Yes or No (Dummy= 0 for No and 1 for Yes)
KedzikopeTown	If the respondent lives in Kedzikope, Yes or No (Dummy= 0 for No and 1 for Yes)
SelarkopeTown	If the respondent lives in Selarkope, Yes or No (Dummy 0 for No and 1 for Yes)
GPSLongs	GPS Longitude coordinates
SLRGlac	Whether climate change is the cause of Sea Level Rise, Yes or No (Dummy 0 for No and 1 for Yes)
SLRPerm	Whether sea level rise is permanent, Yes or No (Dummy =0 for No and 1 for Yes)

1.3.5. Characteristics of the Respondents

The survey results for personal, economic and social characteristics of respondents are shown in the Table 0.2 below. The results of the questionnaire distributed for the study showed an average

age of approximately 48 years while about 44% of these respondents are females and about 56% are males. Also, concerning educational status, almost 41% of the respondents have no formal education, about 46% have primary education and about 11% with secondary education while less than a percentage have tertiary education. The average family size of respondents is approximately 7 people. Averagely, respondents work approximately 6 days in a week and 10 hours in a day. Again, with respect to the livelihood options, most of the respondents are involved in fishing activities. For instance, about 69% of the respondents are involved fishing activities only, 6% are involved in fishing activities and other activities, less than 1% involved in fishing activities, salt mining activities and other activities. Furthermore, salt mining comes as another livelihood option respondents are involved in. About 3% are involved in just salt mining activities while about 8% are involved in both salt mining and fishing activities while approximately 1% is involved in salt mining activities and other activities. Lastly, 12% of the respondents are involved in other activities other than either fishing activities and salt mining activities. The fishing activities include mainly; fishing (beach seine, pair seine, toga and poly fishing), fish monging as well as selling and buying of fish among others. On the side of salting, the main activities are; mining of salt, buying and selling of salt and laborer working. With respect to the respondents involved in other activities, most of them are petty traders (selling food stuff, selling cooked food, operating drinking bars), carpentry, driving among others. When questions were asked about whether they receive relief items when there's coastal flooding from government, NGOs and family members, about 41% of them responded that they have received mainly items in the form of food, shelter items other items from the government. About 33% have received these same items from NGOs and private people while only about 18% have received help from family members.

Table 2. Descriptive Statistics of respondents' characteristics

Respondents' Characteristics	Variable Description	Standard			
		Mean	Deviation	Min	Max
Age	Age	48.300	12.759	20	90
GenderD	Gender	0.558	0.497	0	1
Edu2	Education	0.587	0.492	0	1
NewMaritalStatus	Marital Status	0.650	0.477	0	1
Workdays	Working days	5.846	0.688	1	7
Workhours	Working hours	10.458	2.627	1	24
HHnum	Household number	7.329	3.817	1	27
Fishingactivities	Fishing activities	0.832	0.374	0	1
Saltminingactivities	Salt mining activities	0.132	0.339	0	1
Otherlivelih	Other livelihood activities	0.200	0.400	0	1
Income1	Income group 1	0.366	0.482	0	1
Income2	Income group 2	0.404	0.491	0	1
income3	Income group 3	0.229	0.420	0	1
AdinaTown	Living in Adina	0.490	0.501	0	1
AmutinuTown	Living in Amutinu	0.225	0.418	0	1
KedzikopeTown	Living in Kedzikope	0.185	0.389	0	1
SelarkopeTown	Living in Selarkope	0.097	0.297	0	1
GPSLongs	GPS Longitude	1.055	0.034	0.984	1.189

1.3.6. Respondents' perception of Sea Level Rise Experiences

Respondents of the study were asked a dichotomous (“Yes/No” response) question about whether they are experiencing Sea Level Rise (flooding) or not. The same preamble was used to inquire whether they believe climate change is the cause of sea level rise, whether they are able to cope with the rise and whether they think the phenomenon is temporal or permanent. After respondents were asked if they are experiencing rise in sea levels, those that responded yes were further asked if they believed climate change to be the cause of the rise in sea levels they are experiencing, if they are able to cope in that regard and whether they believe SLR is temporal or permanent.

Figure 5. in appendix shows the response from the knowledge of sea level rise. About 91% of respondents testify that the sea levels are rising and just about 9% responded think otherwise. This response is consistent with the study of Alcantara, et al., (2022). Narrowing it to gender, about 85% female respondents are aware that SLR is happening and about 95% of male respondents also are aware of the rising sea levels. Generally, respondents have knowledge about sea level but a higher percentage of male respondents have in knowledge as compared to their female counterparts. This can be attributed to the fact that males are in most cases the bread winners in the households thus, their activities are affected the most therefore their being aware of the rising in sea levels. Furthermore, from Figure 6., shows that among the people that believe sea level rise is happening, approximately 31% do not believe climate change is the cause while approximately 69% think otherwise. Thus generally, respondents believe climate change causes SLR and this believe is also consistent with the study of (Alcantara, et al., 2022; Taguiam & Quiambo-Marquez, 2016). Among the people who are not aware that climate change in the form of the melting of glaciers is the reason behind SLR (Figure 7.), most of them believe that the phenomenon is as a result sand winning. The same percentage (31%) of people who believe sand winning also believe SLR happens on its own. Few people have no idea about the cause of SLR while a few think that the construction of the Tema harbor has caused flooding resulting from SLR. Of course, there are respondents who have other views about the cause of SLR including superstitious beliefs among others. Such respondents represent about 17.5% of people who do not think climate change is the cause of SLR.

Again, from Figure 8., only 4.5% percent of respondents who responded in the affirmative to the question of whether sea level rise is happening or not are able to cope with the consequences of

sea level rise while over 90% are unable to cope. Thus generally, people do not have the capacity to cope. This finding is quite the opposite of the findings of Ali & Syfullah, (2017) where their findings suggested respondents think they can cope with the risk of sea level rise. Also, in gender wise, a higher percentage of females are able to cope better as compared to the percentage of male respondents however, the difference is not so significant as a percentage of 4.8% of females are able to cope against 4.5% of males. It is therefore not wrong to conclude that both males and females are unable to cope amidst the effects of SLR since the number of people who can cope is not significant in both genders. Finally, from Figure 9., it is inferred that less 1% percent of respondent who answered to whether is sea level rise is permanent or not think the phenomenon is not permanent as against about 99% who believe it's permanent. This also contradict the findings of Covi and Kain (2016) where it was found out that people perceive sea level rise to be temporal at a given level and it is spatially distributed. Also, both males and females have almost the same percentage when it comes to the permanency of the phenomenon. 99.6% of females who are aware of the rising sea levels believe SLR has come to stay while 99.5% of males who are aware of sea level rise believe as well that SLR is permanent. It's again safe then to say that generally, respondents have the thought that flooding being caused by SLR isn't disappearing anytime soon.

The maps (Figure 10. and Figure 11.), is a pictorial view of the extent of rise of the sea level using the Geographical Information System (GIS) mapping. The two maps center on how far the sea has entered the land in relation to the case study areas. Respondents were asked to describe in meters how far they believe the land has been covered by the sea or how far the sea has moved inwards based on their location. Figure 10. represents the communities interviewed from the Ketu South Municipality namely; Adina, Selarkope and Amutinu towns. In this district, the map depicts that a good number of people believe that the sea has moved inwards or inland between 0 and 30 meters. A considerable number of people are also of the view that the sea has moved inwards between 31 and 58 meters. A number of people fall between the 59- and 93-meters category while a few respondents are of the view that the movement of the sea towards the inland is between about 94 and 300 meters. Concerning the Keta municipal (Kedzikope), the Figure 11. shows the most respondents believe the inland movement of the sea is between 31 and 58 meters while a considerable number are of the view that the movement is between 0 and 30 meters as well as 59 and 93 meters. A few respondents fall between the 94- and-150 meters

category while a very insignificant number falls between the 151- and-300 meters category. Generally, respondents of both municipalities confirm the movement of the sea into the inland (flooding) as a result of SLR. There's little difference in the extent of flood in terms of distance as far as the districts are concerned. However, it can be inferred that within the Ketu South district most respondents believe the range of the flooding is between 0 and 30 meters while in the Keta Municipal, most of the respondents are between the 31-and-58 meters category. In all, the differences in meters from respondents can be attributed to their particular location in the areas, the age as well as their experience with the flooding.

Figure 12. depicts the conjoint of variables which explain the knowledge of sea level rise in the various towns of case study. These variables are namely: the knowledge of SLR (SLRKnow), The prior news respondents have about SLR (SLRNews), The ability to cope now (SLRCope), The ability to cope in the future (SLRFutCap), The effects respondents experience as a result of SLR induced flooding (SLREffect) and The properties lost due to SLR (SLRPropLoss). Conventionally, all the towns (Adina, Selarkope, Amutinu and Kedzikope) respectively have barely prior information to flooding, they are unable to cope now and, in the future, they experience significant effects including property loss and thus, have a considerable amount of knowledge on sea level rise. Comparatively, Selarkope experiences the highest loss in property loss with Adina experiencing the least. Again, Adina experiences the highest in terms of the bulk of effects while Kedzikope experiences the least though the differences are not so much.

1.4. Result and Discussion

1.4.1. Econometric Estimation of Perception of Sea Level Rise

To start with, a multi-collinearity test was carried out to know the collinearity between the variables before the major regressions. For this study, the Variable Inflation Factors (VIF) method of multi-collinearity testing was employed. The VIF determines the strength of the correlation between the independent variables. By regressing the variables against one another, the VIF is predicted. The VIF test shows the non-existence of multicollinearity. The results of the multi-collinearity tests are shown in the appendix. A recursive Bi Probit Model (rbiprobit) was then employed to analyze the factors influencing the perception of the sea level rise. The rbiprobit was considered because first, the logit model to analyze the determinants of peoples'

perception of climate change as the cause of sea level rise had its main variable (SLRKnow) being a dependent variable. The details are explained in the methodology.

The Recursive Bivariate Probit Model is selected to identify the relevant variables that determine whether respondents perceive sea level rise or not and whether they believe it's as a result of climate change or not. Thus;

$$SLRGlac_1^* = x \beta + \alpha SLRKnow_2 + \epsilon_1 \tag{3}$$

$$SLRKnow_2^* = z \gamma + \epsilon_2 \tag{4}$$

$$\begin{aligned} SLRKnow_i = & \beta_0 + \beta_1(\text{GenderD}) + \beta_2(\text{Age}) + \beta_3(\text{NewMaritalStatus}) + B_4(\text{workdays}) + \\ & \beta_5(\text{workhours}) + \beta_6(\text{HHnum}) + \beta_7(\text{Fishingactivities}) + \beta_8(\text{Saltminingactivities}) + \\ & \beta_9(\text{SLRCope}) + \beta_{10}(\text{SLREffect}) + \beta_{11}(\text{SLRPropLoss}) + \beta_{12}(\text{SLRDisplace}) + \beta_{13}(\text{Income1}) + \\ & \beta_{14}(\text{Income2}) + \beta_{15}(\text{KedzikopeTown}) + \beta_{16}(\text{AmutinuTown}) + \beta_{17}(\text{SelakorpeTown}) + \\ & \beta_{18}(\text{GPSLongs}) + \epsilon_2 \end{aligned} \tag{5}$$

$$\begin{aligned} SLRGlac_i = & \beta_0 + \beta_1 SLRKnow + \beta_2(\text{GenderD}) + \beta_3(\text{Age}) + \beta_4(\text{NewMaritalStatus}) \\ & + B_5(\text{workdays}) + B_6(\text{workhours}) + B_7(\text{HHnum}) + B_8(\text{Fishingactivities}) \\ & + B_9(\text{Saltminingactivities}) + \beta_{10}(\text{SLRCope}) + \beta_{11}(\text{SLREffect}) \\ & + \beta_{12}(\text{SLRPropLoss}) + \beta_{13}(\text{SLRDisplace}) + \beta_{14}(\text{Income1}) + \beta_{15}(\text{Income2}) \\ & + \beta_{16}(\text{KedzikopeTown}) + \beta_{17}(\text{AmutinuTown}) + \beta_{18}(\text{SelakorpeTown}) \\ & + \beta_{19}(\text{GPSLongs}) + \epsilon_1 \dots \dots \dots \tag{6} \end{aligned}$$

At the end of the analysis, it was expected that, Age, GenderD, Edu2, NewMaritalStaus, workdays, workhours, HHnum, Fishingactivities, saltmining activities, SLRCope, SLREffect, SLRPropLoss, SLRDisplace, Income1, Income2, KedzikopeTown, AmutinuTown, SelarkopeTown and GPSLongs all would have a positive influence on SLRKnow. It is in turn expected that SLRKnow would also influence SLRGlac.

Again, a binary logistic regression model was also employed to examine the factors that influence respondents' capability to cope. Tables 0.3 and 0.5 show the results of the rbiprobit and binary logistic regressions respectively.

$$\begin{aligned}
SLRCope_i = & \beta_0(cons) + \beta_1(Gender) + \beta_2(Age) + \beta_3(Edu) + \beta_4(NewMaritalStaus) \\
& + \beta_5(workdays) + \beta_6(HHnum) + \beta_7(dependants) + \beta_8(Fishingactivities) \\
& + \beta_9(Saltminingactivities) + \beta_{10}(SLREffect) + \beta_{11}(AdinaTown) \\
& + \beta_{12}(SLRPropLoss) + \beta_{13}(SLRDisplace) + \beta_{14}(Income1) + \beta_{15}(Income3) \\
& + \beta_{16}(SLRKnow) + \beta_{17}(GPSLong) + \mu
\end{aligned}$$

At the end of the analysis, was expected that the GenderD, Edu2, workdays, Fishingactivities, Saltmining, Income3, GPSLongs, AdinaTown, SLRKnow and NewmaritalStatus would positively be related to the ability to cope while age, HHnum, dependents, SLRDisplace, SLRPropLoss, Income1, SLREffect would negatively influence the ability to cope (SLRCope)

Table 3. represents estimates of rbiprobit regression of the knowledge of Sea Level Rise and knowledge of climate change as the cause of Sea Level Rise. The rbiprobit of the knowledge of Sea Level Rise and the knowledge of Sea Level Rise are reported in the same table because the rbiprobit consisted of these two dependent variables where one becomes an independent variable of the other subsequently. The knowledge of Sea Level Rise (SLR) which is a dependent variable on its own becomes an independent variable of the knowledge of climate change as the cause of Sea Level Rise. The estimates are computed using sample data obtained from survey questionnaire data.

Table 3. Estimate of recursive probit regression based on respondents' knowledge about SLR and whether climate change is the cause of SLR.

Variables	CC Knowledge	Standard Errors	SLR Knowledge	Standard Errors
<i>SLRGlac</i>				
<i>Key Variables</i>				
0.SLRKnow	0.000	(.)		
1.SLRKnow	-0.766	(1.05)		
SLRCope	0.591*	(0.34)	-0.607	(0.54)
SLREffct	-0.058	(0.25)	0.587	(0.37)
SLRPropLoss	-0.241	(0.17)	-0.004	(0.31)
SLRDisplace	-0.191	(0.18)	0.851*	(0.48)
<i>Household Characteristics</i>				
GenderD	0.060	(0.16)	0.174	(0.28)
Age	-0.006	(0.01)	-0.015	(0.01)
Edu2	0.230	(0.16)	0.187	(0.26)
Workdays	0.137	(0.11)	0.345***	(0.13)
Workhours	-0.065**	(0.03)	-0.026	(0.05)
HHnum	-0.004	(0.02)	0.122**	(0.05)
Fishingactivities	0.566***	(0.21)	0.054	(0.33)
Saltminingactivities	0.184	(0.22)	-0.272	(0.43)
Income1	0.831***	(0.21)	0.688*	(0.39)
Income2	0.333*	(0.19)	0.266	(0.33)
KedzikopeTown	1.069**	(0.53)	-2.492***	(0.67)
AmutinuTown	-0.246	(0.19)	-0.047	(0.42)
SelakorpeTown	2.045***	(0.54)	2.969***	(0.72)
GPSLongs	11.179***	(3.34)	-2.181	(5.36)
_cons	-11.359***	(3.68)	1.964	(5.82)
<i>R²p</i>				
II	-265.186			
Aic	616.373			
Bic	782.846			
P	0.000			
N	408.000			

Robust Standard Errors in Parenthesis. *****, * indicate significant levels at 1 %, 5% and 10% respectively.

ⁱIncome3 (respondents who earn annual income above GHC 10, 000) is used as reference income. ⁱⁱAdinaTown (respondents who live in Adina town) is used as the reference town. ⁱⁱⁱOtherLivelih (respondents who other livelihood activities) is used as reference livelihood activity

Table 4. Description of Variables in the regression

<u>Variables in regression estimates</u>	<u>Description</u>
	Knowledge of Sea Level Rise
SLRKnow	Rise
SLRCope	Ability to Cope
SLREffEffect	Affected by Sea Level Rise
SLRPropLoss	Property Loss
	Displacement by Sea Level Rise
SLRDisplace	Rise
GenderD	Gender
Age	Age
Edu	Education
NewMaritalStatus	Marital Status
Workdays	Working days
Workhours	Working hours
HHnum	Household number
Fishingactivities	Fishing activities
Saltminingactivities	Salt mining activities
Income1	Income group 1
Income2	Income group 2
KedzikopeTown	Lives in Kedzikope
AmutinuTown	Lives in Amutinu
SelakorpeTown	Lives in Selarkope
GPSLongs	GPS longitudes

The results indicated a significant positive relationship between the number of days one works (Workdays) and the knowledge or the awareness of sea level rise (SLRKnow). That is, the more days you work the more you are aware that the sea levels are rising which intuitively is reasonable. Moreover, the higher the number of people in the household, the more likely one becomes aware of sea level rise. Even if the respondent does not know of sea level rise, there is a possibility that a member of the household may tell the household head about it. Also, people who earn annual income within Ghc100 and GhC 5,000 are more likely to know more about sea level rise compared to those who earn above 10,000. Intuitively, the less money you have to cope, the more you experience the effects of sea level rise hence, the knowledge of it. Furthermore, displacement has a significant positive influence on knowledge of sea level rise. the more people are displaced by the rise in the sea level, the more they know about sea level

rise. The more people live in Kedzikope, the less likely they know about sea level rise as compared to people who live Adina town. This is justifiable because a sea defense has been constructed in some part of Kedzikope hence the effect of sea level rise is not felt that much making it less likely to know about sea level rise. However, the people in Selarkope are more likely to know about sea level rise compared to people who live in Adina. Unfortunately, from the results, the more people are capable to cope, the less likely they know about it which may not be reasonable and not in line with literature but it can be argued that the more people are able to cope, the less they are likely to be affected by sea level rise therefore the less they know about it.

From the results again, it is observed that the more hours one works, the less likely they are to know that climate change is the cause of the rise in sea levels. Also, the more one is involved in fishing activities the more they are likely to know that climate change is the cause of sea level as compared to other livelihood options. Of course, people who engage in fishing activities depend on the sea a lot comparatively thus knowing much about the rise in sea level and consequently its cause. Furthermore, the more people are able to cope, the more they know that climate change is the cause of sea level rise. The people within the income class 1- and 2-income groups (100---5,000 and 5,000---10,000) also have the tendency of knowing the cause of sea level rise to be climate change compared to those who earn annual income above GhC 10,000. The people who reside in the towns Kedzikope (KedzikopeTown) and Selarkope (SelarkopeTown) also are more likely to know that sea level rise is being influenced by climate change compared to people who live in Adina. With respect to the longitudinal coordinates, the higher the longitudinal coordinates, the more respondents know of climate change as the cause of climate change.

Table 5. Logit estimates of Coping Capabilities

Variables	Coefficient	Standard Error
SLRCope		
GenderD	0.357	(-0.63)
Age	-0.054*	(-0.03)
Edu2	0.492	(-0.65)
NewMaritalStatus	0.000	(-0.61)
Workdays	-0.236	(-0.25)
HHnum	-0.238*	(-0.13)
Fishingactivities	0.093	(-0.77)
Saltminingactivities	0.924	(-0.81)
SLREfffect	-0.404	(-1.16)
AdinaTown	2.995***	(-1.04)
SLRPropLoss	0.559	(-0.64)
SLRDisplace	-0.633	(-0.64)
Income1	1.354**	(-0.67)
Income3	0.035	(-0.93)
SLRKnow	-1.048	(-1.5)
GPSLongs	3.272	(-17.13)
_cons	-3.613	(-17.92)

Robust Standard Errors in Parenthesis

***, ***, * indicate significant levels at 1 %, 5% and 10% respectively

ⁱAmutinu, Kedzikope, and Selarkope are the reference towns

ⁱⁱIncome2 (people who earn an annual income within 5,000 and 10,000 cedis) is used as reference income

ⁱⁱⁱOtherlivelih (other livelihoods) is used as reference livelihood

From the logistic regression, it is seen that age is significantly negatively related to the ability to cope. Thus, the older respondents get, the more the it becomes difficult for them to cope with the

effects from sea level rise. The older one gets, the more it becomes difficult to work hard and gain income as well as other materials to help them cope effectively. Moreover, household number has significant negative relationship with the ability to cope with SLR. So, when the household number is large, the less likely the household has a capability of coping. That is, when the dependency ratio of the household is high, the less likely there is a room for enhancement of coping abilities. The ability to cope again is also significantly positively influenced by the variable: AdinaTown. This means that, the people of Adina have a higher coping capability comparatively to the people who live in Kedzikope, Selarkope and Amutinu. Finally, the variable (Income1) has a significant positive influence on the ability cope. The respondents who earn an annual income between GhC 100 and GhC 5000 are able to cope comparatively to respondents who earn annual income between GhC 5,000 and 10,000. One would have thought that those with the lowest income group comparatively may not have the ability to cope intuitively, but it is the opposite in this study.

The perspective of this study is finding how people view sea level rise and climate change in general. Thus, to know if people are aware of and are experiencing flooding, to know if the flooding is induced by climate change and if they in case they are experiencing flooding or if they are being affected by flooding, are they able to cope? Regarding this study, these are the components that constitute the perception of sea level rise or how the public perceive sea level rise. Notedly, sea level rise is proxied or seen here as coastal flooding. The limit to this perspective is the communication of the ideas to respondents in order to get the right response towards the perspective. A number of respondents had not had any form of formal education and so some terms as sea level rise, climate change and coping capabilities had to be broken down in the local terms which was quite difficult. In estimating the meters that the sea had moved inlands, respondents could not properly measure distance in meters thus, surveyors had to do much work in getting the correct estimates from it.

1.5. Conclusion and Recommendation

This study set out to find the perception that coastal dwellers have about sea level rise while exploring some coping mechanism of these coastal dwellers amidst the rising sea levels The results obtained confirms literature including Taguiam and Quiambo-Marquez, Alcantara, et al.,

(2016; 2022) that the sea levels are rising and it's already affecting the wellbeing of people. From the various results estimates, it is clear that sea level rise is not a hearsay, an illusion or a misconception but a case of reality and almost everyone around the coast is aware of it. From the case study area, about 91% of the respondents are aware that the sea levels are rising and this is in accordance with literature including (Alcantara, et al., 2022). Coastal residents are aware that climate change is the cause of sea level rise. At least, the results have shown that over half of the respondents which represent the majority believe climate change to be the cause of the rise in sea levels. However, despite the effects on livelihood activities, and other life activities, residents have endured and continue to live in their current places because to most of them, that is their home where they identify themselves as the custodians of the land. To them, they have not known any other lives aside what they have now where they can trace their roots. Leaving their current places would mean changing livelihoods which some are not willing to do. Changing livelihoods means changing the lives they have been used to despite their inability to cope.

The results from rbioprobit showed that out of 19 independent variables, household number (HHnum), residents from Kudziko town (KudzikoTown), residents from Selarko town (SelarkoTown), people within the annual income 100---5,000 cedis range (Income1), people who have been displaced (SLRDisplace) and work days (workdays) were found to be significantly related to the knowledge of sea level rise component of perception. That is, the knowledge of sea level rise is being influenced by town of abode, the annual income levels of individual, the displacement of individuals, the number of persons in a household and the number of days individual work. However as against Slovic (1999), gender and age do not significantly affect one's perception of climate change. Also, the same rbioprobit results showed that out of 20 independent variables, the hours respondents work (workhours), respondents who engage in fishing activities (Fishingactivities), the ability to cope (SLRCope), respondents who are in the 100---5,000 cedis income range (Income1), individuals who are within the 5,000 and 10,000 cedis income range (Income2), respondents who reside in Kudziko town (KudzikoTown), respondents who reside in Selarko town (SelarkoTown), and the longitude coordinates of the GPS (GPSLongs) were found to be significantly related to the knowledge of climate change as the cause of sea level rise. Thus, the knowledge of climate change as the cause of sea level rise is significantly influenced by the town of abode, the hours one works, the livelihood activity, the ability to cope and the annual income earned. Furthermore, from the

logistic regression, it is observed that out of 16 independent variables, household number (HHnum), the age of the respondent (Age), respondents who live in Adina town (AdinaTown) together with respondents who earn an income within 100 and 5,000 cedis (Income1) are significantly related to the ability to cope amidst sea level rise. Therefore, one's ability to cope is influenced by their age, the number of people in their household, the town they live in and their income.

Finally, it can be inferred from the analyses above that people perceive the existence of sea level rise with the majority believing that climate change is the cause of sea level rise. The various results depict that peoples' perception about sea level rise are influenced by their location (where they live), their livelihood activity, the number of people in their household, their age, the income they earn and their ability to cope amidst sea level rise. Basically, perception of sea level rise is based on geographical location and socio-economic characteristics as against the results of (Combest-Friedman, et al., 2012) where socio-economic characteristic doesn't affect the perception of sea level rise.

It is recommended that respective authorities, especially government and non-governmental organizations create policy measures that focus on the influential factors of coastal dwellers' perception about sea level rise. This may significantly enhance victim's ability to reduce risks of losing so much as a result of sea level rise. These policy measures may touch specifically on capacity building for residents of coastal areas, institutional support, easy way of receiving relief items and accountability of staffs of authorities involved in distributing relief items. The limitation of this study centered on communicating the perspective of the study to the respondents in the language they understand in order to get the right responses.

ESSAY 2. Assessing the cost of sea level rise to coastal livelihood.

2.1. Introduction

The coastal arenas have continuously attracted economic agents on the account of booming economy and quality of life (Kron, 2013) yet the rising sea levels have left coastal dwellers in situations where their comfort is being compromised. Sea level rise remains one of the immense impacts of climate change which postures dangerous threats to livelihood options and a great number of physical properties. Sea level rise is not a hypothetical phenomenon but it's in existence (Yoskowitz, et al., 2009) that great number of people and assets are already being affected (Bosello & De Cian, 2014). Through coastal flooding, salt water intrusion, wetland reduction and coastal erosion, economic growth and human development are affected (Nicholls, 2011; Ehsan, 2016; Fu, et al., 2016). Unusually high waves are destroying fishing equipment as well as commercial and public infrastructure (Dovie, et al., 2014). Gradually, Sea level rise is being recognized as a pull factor for migration which goes beyond livelihood and reshape the population distribution (Hauer, 2017).

The economic consequences of climate change have triggered the need of finding solutions to victims or vulnerable people. There is the need for urgent response in the form of enforcement of adaptation policies and some sort of coping mechanism. Climate Risk Interventions are necessary not only from public and private sectors but also on the part of the individuals being affected. According to Solomon et al., (2007), adaptation to climate change is any adjustment activities of humans in order to abate their vulnerability and that of the ecosystems to climate change. Advantages that come from adaptation could be direct and indirect and they include; the avoidance of interruptions in businesses, physical damages, loss of working days while providing some sense of accountability and security to both the current and future generations (Ehsan, 2016). Sea walls, dikes, barriers for storm surges, banning of land along the coast and geo-tubes are some common adaptation measures usually done in coastal areas.

However, for efficient and cost-effective adaptation options, it remains necessary to measure economic costs and damages caused by sea level rise for public policies evaluations and allocation of resources for adaptation (Fu, et al., 2016). In order to strengthen evidence-based abatement policies, it is important to evaluate the physical impacts and correspondently assess

economic losses (Cui, et al., 2018). In the nut shell, climate change damage estimates are crucial prior to designing climate change policies (Hsiang, et al., 2017). The debate on how much sea levels will rise still lingers nevertheless, it is practically certain that sea levels are rising and the trend will persist (Fu, et al., 2016).

Future consequences of climate change may be detrimental however, if adequate measures are adopted, they could be substantially mitigated (Senevairante, et al., 2012; Church, et al., 2013; Wong, et al., 2014). Studies related to the estimation of the economic cost of sea level rise are scanty in comparison to studies related to coastal hazards. There have been attempts by researchers to quantify the cost of sea level rise primarily based on Yohe (1989) and further developed in Yohe, et al., (1996) and Yohe & Schlesinger, (1998). These are evolutions of estimating potential cost of sea level rise in the future measured by estimating the total benefits and costs components in the future. Here, the challenge centered on estimating values in the future amidst depreciation and uncertainties. However, this study seeks to assess the cost of sea level rise to coastal dwellers now by using the willingness to pay approach thus, measuring the cost that sea level rise renders coastal dwellers by measuring their willingness to pay for insurance packages.

Objectives of the Essay

The principal objective of this study is to assess the cost of sea level rise to coastal dwellers using the willingness to pay approach.

To help achieve this principal objective, the following specific objectives would be explored:

Evaluate the effect of attribute-based insurance on preferences.

Estimate the potential amount that coastal dwellers are willing to pay for potential insurance packages.

Plan Activities

The aim of this essay is to assess the cost of sea level rise to coastal dwellers using the willingness to pay approach. Specifically, this essay seeks to evaluate the effect of attribute-based insurance on preferences as well as estimate the potential amount that coastal dwellers are willing to pay for potential insurance packages. Analyzing the objectives of this study, the essay

has been organized accordingly. The organization of this essay is in 5 sections. The first section covers the introduction to the essay, the objectives of the essay, the plan activities of the essay as well as some stylized facts. The second section explores related literature to the essay. The Literature review is basically in two parts. The first part (Theoretical Literature) talks about existing theories concerning the subject matter. The second part of the literature review also is the Empirical literature. Here, related studies of the subject matter are explored. The literature review section helps guide in using the best theory and methods for the study as well as identifying the gaps in previous studies in order to explore those gaps. The third section is the methodology section. This section also highlights on the case study area of the study, the variables considered for the study as well as the theoretical and empirical methods used for the research. Moreover, section four analysis the findings from the empirical methods. This section presents the results and discusses them as well. Finally, section 5 presents the conclusion of the essay based on the results and discussions as well as making recommendations.

2.1.1. Stylized Facts

Sea level rise among the climate-induced threats to the coastal region is the most serious (Cui, et al., 2018). Sea Level Rise and its accompanied flooding affect vast livelihoods of many coastal dwellers globally. The mean global temperature increase causes the ocean water to undergo thermal expansion coupled with land-based icebergs and mountain melts resulting in rising sea levels (Deke, et al., 2001). According the National Geographic Society, (2011) the coast is the land along the sea. Short & Woodroffe (2009) also define coastline as the boarder coastal zone and shoreline as the point where the land is met by the ocean. In the coastal zones, important economic activities which include fisheries, agriculture, tourism and harbor activities take place. Again, according to Nicholls, et al., (2014), the assets of major cities across the world was approximately 3,000 billion (2005 US\$) which they hypothesized that the hinge to coastal settlement, especially in developing countries would upsurge in response to interaction with population growth and economic significance of coastal cities. Correspondingly, the rise in sea levels is a global concern because of the dangers it poses on coastline properties (Bosello & De Cian, 2014). The rise in sea level which increases the inundation of many low-lying coastal zones Karegar, et al., (2017) and consequently take a toll on livelihood options and progress of the coastal zone. Rising sea levels are assumed to have four damage components namely; the value of dryland lost, the value of wetland lost, the cost of production against rising sea levels

and the costs of displacement of people (Anthoff, et al., 2010). Sea level rise and its effects have been widely studied and understood among both developed and developing coastlines (West, et al., 2001). Livelihoods are affected when people are forced to resettle or migrate or other forms of mobility (Care for Shelter, 2008). It is estimated that globally, 20 million people inhabit in places below normal tides while about 200 million are vulnerable to flooding during extreme sea level events (Nicholls & Cazenave, 2010). For instance, climate change has been a push factor for Dangme East District in Ghana to migrate in a large scale in search of other livelihood options since their current livelihood has been affected directly or indirectly. Physical infrastructure, natural, social and economic systems as well as health systems are all being destroyed in various communities and having a toll on peoples' livelihood. Various studies confirm that the global sea level rise will continue in the 21st century (Amidu, 2016). Hence, over 56 million people in developing countries are liable to be affected by a meter rise in global sea level rise (McLeman, 2014). Notedly, sea level rise and other climate change phenomena out of proportionately affect women. This is because, already, females are likely to be poor, and are confronted with vulnerabilities which intensify when there is instability (McCarthy, 2020). Therefore, it comes as no surprise that the Paris Agreement makes special provisions to enable women acquire assistance to cope with hazards that come with climate change. Even within the coastal zones in various African countries, the poor suffer the most in the light of sea level rise. Wealthier households may be able to adapt to reduce damages or even relocate and engage in other livelihood opportunities while less endowed are unable to engage in any. In addition, given the economic cost of coastal inundation, and the potential impacts of sea level rise compared with adaptation capacities, Sub-Saharan Africa is set to a state of devastation.

In trying to deal with the impacts of sea level rise, traditional approaches could create a chain reaction or a domino effect of environmental and economic consequences for nearby communities (Cafasso, 2021). Methods like building sea walls could render damages worth millions to nearby communities as well as destroying habitat life for aquatic species. Again, there is a growing awareness that solutions from civil engineering solutions are not sufficient thus, for sustainable flood management, more work is needed (Crichton, 2008). In as much as architects may have important roles to play in situations like sea defense, dikes among others (Roaf, et al., 2005), insurance companies as well have a role to play (Crichton, 2018). The good news is that,

some leading companies have appraised adaptation to climate change very commendable (Lloyds, 2006).

2.2. Literature Review

With nearly 41% of the earth's population living within 100km of the coast (McGranahan, et al., 2007) and the surge in coastal settlement (Martínez, et al., 2013), property inundation as a result of global sea level rise could be calamitous (Nicholls & Cazenave, 2010; Ranasinghe, et al., 2012; McGowan & Baker, 2014). Sea level rise manifests in the changing of the shorelines through accretion and erosion. Measuring the physical impacts or damages accrued to sea level rise is necessary for stimulating the ensuing economic impacts (Cui, et al., 2018).

2.2.1. Theoretical Literature

When people experience environmental degradation, they may attempt to allocate some resources to alleviate or reduce the impact of the disaster or the welfare change due to the disaster. Many research analysts have sought to place monetary values on changes in welfare that are due not to changes in price but rather due to changes in the availability of public goods or amenities, quality changes in commodities or fixed quantity changes of rationed goods. The measures which are prevalent in measuring changes in prices are the compensating (C) and equivalent (E) variations thus, the maximum amount an individual is willing to pay (WTP) to secure the changes in welfare or the minimum amount an individual is willing to accept (WTA) in order to forgo the changes in welfare (Hanemann, 1991). WTP and WTA measures are generally used for economic analysis with extensive outcomes for consumer demand, social welfare, policy, marketing and economic theory. WTA for goods and services is assumed to be a reflection of an individual's underlying utility function. As goods and services are consumed in their larger quantities, marginal utility declines and total utility increases at a diminishing rate. Thus, the WTP for interventions remains as long as payment is not beyond budget line (Kamaludin, et al., 2018).

Now for empirical estimation, WTP welfare measure is stated as,

$$Tip = X_i\beta + e_a \dots \dots \dots (1)$$

The vector of explanatory variables is denoted by X_i , β as the vector of parameters and e_a also denoting the error term. By summing up the aggregated benefit of each group of respondents, the total benefit is achieved (Kamaludin, et al., 2018).

It is necessary to ascertain the amount the public is willing to contribute to cover part of the related costs to avoid risks and serious losses in the future. Various fields of study have applied the concept of WTP to assign monetary values for non-marketed goods and services through observed market behavior and market scenarios (Endalew, et al., 2019). The two most commonly used methods for estimating WTP are the revealed preference method and stated preference method depending on the goods and services in question, resources available and time. While the revealed preference technique estimates the use value, the stated preference considers both use and non-use values. The main approaches to stated preference method includes, conjoint analysis, contingent valuation and choice modeling approach. However, contingent valuation (CVM) method and choice modeling approach (CMA) are widely utilized because of their flexibility (Hanemann, 1984; Blamey, et al., 1999; Hanley, et al., 2002; Hamukawa, et al., 2019; Tesfaye, et al., 2019). The CVM has somewhat received its fair share of controversial historical application since the first Australian application decades ago (Blamey, et al., 1999). Concerns raised includes its susceptibility to yea-saying and the related notion of lexicographical responses, the fact that respondents ignore or discount substitution possibilities sometimes and how it may not be well suited for evaluating diverse policy options. These defects of the CVM could lead to biased WTP estimates as well as reduction in sensitivity to scope (Blamey, et al., 1999; Blamey, et al., 1999b; Mitchell & Carson, 2013). However, choice modelling, which is a state preference form and usually called choice experiment is an alternative less susceptible to these limitations. Choice modelling has traditionally been applied to many issues of environmental valuation as it is able to estimate non-use values (Bennett & Blamey, 2001). Choice modelling has its mainspring in conjoint analysis (Adamowicz, et al., 1998) and was originally developed in marketing and transport literature by Louviere & Hensher, (1982) and Louviere & Woodworth, (1983) but over years has been applied across many areas. Comparatively, the application of choice modelling in environmental valuation is recent (Adamowicz, et al., 1994; Rolfe & Bennett, 1996; Hanley, et al., 1998; Blamey, et al., 2000; Bennett & Blamey, 2001).

Various aspects of environmental and resource economics from notable studies in which CM technique has been utilized include; the valuation of remnant native vegetation (Rolfe, et al., 1997), valuation of environmental attributes of rivers (Bennett & Morrison, 2001) and estimating the preservation of tropical rainforest (Rolfe, et al., 2000). The presumption of choice

experiments is that respondents are presented with alternatives in a choice tasks with the assumption that they will choose the alternative that provides the highest relative utility (Louviere, et al., 2000; Train, 2003; Hensher, et al., 2005). Choice modelling is seen as the most adept method for the estimation of the WTP of consumers. In many ways are choice modelling similar to the discrete choice variant of CVM; theoretical basis (Random Utility Theory), the presentation of respondents with a description of options of alternative policies as well finding an indication of the single preferred option. However, as the discrete choice of CVM demands for the respondents to make a choice between a base option and a single alternative, choice experiments make use of a repeated measures approach. That is, predominantly, respondents are presented with multiple choice sets between 6 and 10 with each of the choice sets containing a base option in addition to 2 or 3 alternatives from which they are made to indicate in each choice set option they prefer. The set of options that are contained in each of the questions is called the choice sets. A corresponding current condition or status quo known as the baseline alternative is commonly included in each choice set then a choice is made between the normal status quo and situation and a number of proposed situations. The attributes which characterize the various options vary according to an experimental design which permit estimates of the relative importance of the attributes that underline the options to be obtained (Blamey, et al., 1999). Respondents are questioned about a sample of events drawn out from the universal possibilities of events of that type as opposed to CVM analysis where respondents are questioned about a single event in details (Boxall, et al., 1996, p. 244). The differences in attributes may reduce yeasaying occurrences and other related biases especially when the options do not have labels which are emotionally infused that respondents could attach their responses (Blamey, et al., 1997).

Again, within the utility approach, value can also be expressed in WTA compensation for distress. This method of WTA has proven useful given that preferences directly taken from respondents is what it relies on. Yet the way questions are being phrased could affect results, that is, when the questions raise psychological and cognitive matters (Abrate, et al., 2016). There have been studies including Hartman, et al., (1991) which have had WTA values being higher than WTP values and also that self-stated WTA a quite lower than from choice experiment. Generally, WTP and WTA vary however, WTA outweighs WTP in monetary estimate values as result of factors closely related and referred to as anomalies consumer behavior (Kahneman et al, 1991).

Climate change models have predicted that extreme precipitation and flood would increase amid a warming world (Allan & Soden, 2008; Climate Change Science Program (US), 2008). Thus, the need for a keen interest in the management of flood risk. Debates about flood insurances are on-going in many nations across the world and these interests have arisen from the pursuit to discover an efficient way to compensate victims who suffer losses and also to manage the financial risks of uncertain losses (Surminski & Eldridge, 2017). Basically, the risk or part of it is transferred from the insured to the insurer in return for payment known as premium. Different approaches to insurance exist in different countries across the world (Schoubroeck, 1999). In countries where insurance cover exist, the differences in approaches could be classified into options systems and the bundle systems (Crichton, 2002). Under the options systems, Insurers consent to extend their policy to embrace flood payment of an additional premium. In Belgium, Germany and Italy as well as North West territories of Australia, this system can be found although there is very low take up rate (Crichton, 2008). Associated with the options system is the problem of defining what a flood is in order that it can be excluded and the problem of adverse selection. Adverse selection here means that insurers tend to be selective when it comes to customers by making the cover available for areas they view as safe whereas adverse selection on the part of customers means that, customers decide to only buy insurance in areas they consider risky. Adverse selection problems may result in covers being expensive if they are even available at all and there is low market penetration as well. These make such insurances improbable of being sustainable. Sometimes, government may intervene to compensate flood victims reducing the effective demand.

Regarding the bundle system approach, cover for flood is obtainable only if it is bundled with other threats as fire, storm, theft, earthquake among others. In Britain, Israel, Japan, Spain and Portugal, the bundle system is utilized. This system gives the insurers the liberty to charge differential rates however, rate increases can be alleviated due to the reason that, risks are not spread over time but rather, across dangers and across rating areas. That is, people may not necessarily have problems with flood yet, they still may buy flood cover probably in order to get earthquake or storm cover and the other way round. Unlike the option system, the bundle system has much market penetration. Opportunities of adverse selection here, is less as compared the systems because everyone pays for flood insurance whether they think they need it or not. As stated earlier, government may intervene in compensating flood survivors and this involvement

may come in four categories (Crichton, 2008b). These include; no state compensation for citizens though there may be grants for repair, State reinsurance, Catastrophes Naturelles (CATNAT) system and the National Flood Insurance Program (NFIP). In the no compensation system, the disadvantage is that, recovery can be slowed however, it does encourage private insurance. Furthermore, under the state reinsurance system particularly in Belgium, France Italy and Spain, the cover is usually based on individual private on private insurance policies while the state involves itself only in reinsurance and/or situations that are catastrophic. On the issue of CATNAT system in France which has been running since 1982, the government acts as the reinsurer. Also, the Bernier Fund exist and provides loss reduction incentives. This is funded by a levy on insurance premiums which according to Nussbaum, (2004), there are some resentments as those who live in safe areas who in effect are forced to pay for the measures of risk reduction for others. Again, there exist a complex relationship between insurers, the government reinsurers, the state insurance commission, the state guarantee, and local authorities which usually leads to confusion and inertia (Nussbaum, 2004). Finally, for the NFIP in the USA, about 95 insurance companies provide cover and claims handling service in almost all cases however, they pass the premium to the government and recover the costs of claims from the government as well. Here, premium is expensive and the average take up is only about 50%. The scheme was self-funding with U.S. Treasury giving a guarantee that claims would be paid until hurricane Katrina happened. The annual costs never exceeded \$2bn before Katrina but following Katrina, the estimate NFIP claims cost was around \$23bn thus, the scheme is under review (Dixon, et al., 2006).

2.2.2. *Empirical Literature*

Global vulnerability to sea level rise has become worse than previously with projections of rise between 5 and 7 feet and possibly more (Kulp & Strauss, 2019). The rising of the sea levels obviously come with a cost to coastal dwellers and consequently life in the inlands. These have warranted wide research across the cost of sea level rise over damages and adaptation. Research has that climate change and extreme weather-related threat including intense flooding and rise in sea levels would impact coastal resources, communities and livelihoods severely in ways that would subvert their socioecological functioning (Dampha, 2020). The impacts of climate change may include; damages to private properties and public infrastructure, injuries and fatalities, structural loss of Island nations such as Maldives and Kiribati, economic losses to coastal cities,

population drift as well as loss of revenues to government and private businesses alike (Jallow, et al., 1996; Castles, 2002; Beaucchemin & Bocquier, 2004; McLeman & Smith, 2006; Raleigh, et al., 2009; Black, et al., 2011; Kebede & Nicholls, 2011; Horowitz, 2013; McLeman, 2014; Monterroso & Conde, 2015). This section explores some of the studies done on the cost of sea level rise. This helps in gaining more knowledge about the subject matter as well as identifying knowledge gaps.

2.2.2a. Previous studies on Cost and Willingness to pay

Making use of available geospatial data and field measurement to study the topography and the extent of damage of flooding to the Glefe community, Addo & Adeyemi, (2013) assess the impact of sea level rise on the vulnerable Glefe community in Accra, Ghana. The study found that accelerated rise in sea levels will destroy infrastructure and render inhabitants homeless and even endanger birds and wildlife.

Examining three scenarios of sea level rise by the IPCC, Amidu (2016) estimated the potential economic cost of sea level rise on a market land along the Accra coast. The objective was to determine the adaptation option with the least cost. The study employed the cost benefit model used in a previous study by (Yohe, et al., 1995). The study concluded that coastline protection is the best adaptation strategy and also that sea wall construction every 10 years to protect the land is the most affordable protection approach.

Ehsan, (2016) investigated the WTP for adaptation measures to sea level rise of coastal areas in Batu Pahat District, Johor, Malaysia by employing the contingent valuation methods for adaptation measures (the building of a geotube along the coastline), a survey was carried out on 211 local residents. The results indicated that just about 13% of residents are willing to pay for the adaptation measure while the majority about 73% are not willing to pay for the adaptation measure. The study indicated that low income, low education and lack of awareness of climate change issues might have contributed to the low WTP.

Ali & Syfullah, (2017) investigated the impacts of the permanent inundation induced by sea level rise on the livelihood of Beel Dakatia in Bangladesh based on the perception of the local people. The study made use of a survey questionnaire and participatory rural appraisal (PRA) tools and the opinions of people on the on local adaptation techniques for impacts' mitigation was analyzed. Various livelihood parameters' vulnerability were also estimated. The results of the

study showed that the local people think they are capable of coping with an adverse effect by the application of local adaptation techniques for a 30.5cm permanent inundation. However, for a 61cm inundation, they would have to vacate the area.

Budhathoki, et al., (2019) set out to find out why the uptake of crop insurance schemes has been poor in Nepal despite government subsidies. The survey considered 350 farmers and identified factors that influenced farmers' general interest in, as well as their willingness to pay for crop insurance. The study found that low uptake of crop insurance is unlikely to be the premium prices. However, the study suggested that information about threats of climate variability to crops in the future should be better communicated to increase uptake of crop insurance by farmers and also that there should be a revision of the current subsidy.

Liu, et al., (2019) estimated the WTP for a hypothetical excess rainfall index insurance contract of farmers particular having interest in whether recent experience with catastrophic flooding have influence on the attitude of farmers towards the insurance product. Survey Data from small farm households in China's Heilongjiang Province was employed for a natural experiment. The study found that farmers in flood prone areas have higher WTP for index insurance as compared to those from areas that are not flood prone.

Ukpong, (2019) employed Bayesian approach in estimating the WTP for environmental hazards mitigation in Nigerian oil producing areas. The approach estimated the mixed logit model by utilizing the normal and log-normal distributions of WTP parameters. Negative WTP values were estimated for the status quo attribute indicating that Nigerians are not happy about the present situation and condition of the environment. Comparatively higher WTP were estimated for food safety, with poverty and unemployment rate respectively also indicating the respondents' predisposition for mitigating unpleasant impacts on livelihood from resource exploitation. Also, a positive WTP were estimated for water and land pollution from oil spills, gas flaring and land occupied oil and pipelines point to the fact that a larger number of the people brace mitigation policies.

Employing household survey approach and a foundation on New Economics Theory, Dampha, (2020) discovered that in Banjul, The Gambia, people have employed migration as an adaptation strategy in order to avoid the consequences of climate change threatening the Island City.

Respondents were presented with a willingness to migrate where over half of the households expressed the intention of migration if situation remains the same by 2050.

Entorf & Jensen, (2020) studied the WTP for public investment in safety measures particularly, the measures for reducing the risk of natural flood risk. Contingent valuation method was used to collect individual data from a nationwide sample of households in Germany. The median annual WTP was found to be 50 Euros. Also, a multivariate analysis of the determinants of WTP indicated that prior experience with flooding is an important factor. Again, the study indicates that the true ability to pay is highly significant for the stated WTP.

2.2.2b. Previous Studies on Flood risk and Flood Insurance

Kousky & Kunreuther, (2010) examined the history of St. Louis , Mo. In coping with the riverine flood risk over the past 15 years focusing on flood insurance. The study made 6 challenge observations including; many property owners not buying flood insurance, people underestimating flood risk, the need for better flood maps, having a love affair with levees, flood risk increasing over time and taking deep pride in rebuilding after disaster.

Wilby & Keenan, (2012) reviewed steps that were being taken by actors at the international, national, regional and community levels in order to adapt to flood from sources as tidal, fluvial, surface and groundwater. The review was based on existing inventories, national and sectoral adaptation plans, flood inquiries, building and planning codes, city plans, research literature in addition to international policy reviews. The study distinguished between the enabling for adaptation and distinct measures of implementation to the management of risk. Both types of adaptation were identified though relevant challenges for managing flood risks that are transboundary, protection of existing property at risk of flooding and the ensuring of equitable outcomes of risk reduction exist.

Wouter Botzen & Van Den Bergh, (2012) presented a stated preference survey making use of choice modeling with mixed logit estimation methods to examine the effects of climate change and the availability of government compensation on the demand for flood insurance by Dutch homeowners even though there was no private insurance against flood damage. They found that there are opportunities for development of a flood insurance market.

Dubbelboer, et al., (2017) presented an Agent-Based Model (ABM) developed to simulate the dynamic evolution of flood risk and vulnerability and also facilitate an insurance mechanism investigation in London. The ABM focuses on the role of flood insurance, stimulating current public-private partnership between the government and insurers and the forthcoming reinsurance scheme Flood Re, designed as a blueprint for the support of future flood insurance's availability and affordability. A detail GIS and qualitative data of the London borough of Camden are utilized in representing an area at high risk of surface water flooding. The model points out how future development could worsen current levels of surface water flood risk in Camden. Investing in measures of flood protection are indicated to be beneficial for the reduction of surface water flood risk. Again, Flood Re scheme is indicated to have achieved its aim of securing affordable flood insurance premiums though it is placed under progressing pressure in the future as the risk of surface water flooding keeps on increasing.

Surminski & Eldridge, (2017) assessed the current and newly proposed insurance scheme amid the rise in flood risk. Applying their analytical framework, the study found an absence of formal incentive mechanism for the reduction of risk. The study suggested some possible modifications in the flood Re proposal to deliver a greater link between risk transfer and risk reduction.

Kamaludin, et al., (2018) carried a study to estimate the WTP of the people of Kuala Krai in Malaysia for flood intervention program to reduce losses through a contingent valuation program. Questionnaires were distributed to 917 respondents randomly selected. The findings include a mean estimate of the public's WTP to be RM22.71 per household per month which could be used in measuring effectiveness and improvements in the program's implantation. The findings of the study recommended the increase in education about floods and provision of information on causes of flood and actions to be taken amidst floods.

Hudson, et al., (2019) presents the result of a study which aimed at evaluating the ability of flood insurance arrangements in Europe to cope with flood risk trends making use of criteria bordering elements of flood insurance reform policy debate. The study show that average risk-based flood insurance premium could double between 2015 and 2055 in the absence of more risk reduction by households exposed to flooding. Also, the study indicates that part of the expected future increase in flood risk can be limited by mechanisms of flood insurance that better incentivize the reduction of risk by policyholders which abases vulnerability. Again, flood insurance can be

improved by the initiation of key feature of public-private partnerships including; public reinsurance, limited premium cross-subsidization between low and high risk households together with incentives for the reduction of policyholder-risk.

Roder, et al., (2019) used an online survey in studying the perception of flood risk and the willingness to pay for flood insurance in the Veneto region in Italy. The analysis initially proved that flood knowledge is high however, it may not be enough to encourage proactive risk management. The willingness to pay analysis show that the reluctance of people to buy insurance yet, respondents would accept the insurance if they are made compulsory.

As seen above, several studies both quantitative and qualitative have been done using willingness to pay approach on crop insurance as well as other environmental and non-environmental intervention programs. Again, there have been some other flood intervention programs. One may ask how this study is different from those studies. This studies differs mainly in terms of the goal of the study and the case study area. There are studies cited that have worked on WTP, few on WTP for intervention programs such as adaptation programs however, the willingness to pay for flood insurance barely exist especially in West Africa and for that matter Ghana. The studies that have been done on flood insurances are mainly in advanced countries and those mostly estimate the impact of the flood insurances. Stand-alone environmental flood insurance does not exist in Ghana. Therefore if flood insurances should be considered in Ghana in fighting coastal flooding, there is the need to investigate the willingness to pay for them on the part of the victims of flood. Hence, this study in needful. Again, in this study, the choice modelling approach is considered as against the favorite contingent valuation method which have deficiencies that are less likely in choice modelling approach.

2.3. Methodology

Planning incentive programs that are both efficient and effective requires that one understands the necessary resources to incentivize the sufficient number of households to move from present location (coast) and possibly engage in other livelihood options. Again, such programs could give resources required to supplement cuts in proceeds of livelihood resulting from sea level rise and or resources required to deal with the effects of sea level rise so as to avoid the cuts in proceeds of livelihood. This study explores the willingness to pay of coastal dwellers for

insurance packages which may help deal with the effects of sea level rise that reduce the proceeds of various livelihood options.

2.3.1. *Theoretical Methodology*

Choice experiments remain a preferential method suited to the design incentive programs. Choice experiments have their roots in conjoint analysis which have extensively been utilized in market research (Blamey, et al., 1999). Both CM and CVM a basis of theory in random utility Theory (RUT) originally developed by (Marschak, 1960). Also, the CM technique also has a basis in the characteristic's theory of value (Lancaster, 1966). From (Train, 2003), In derivin.g the RUT, a decision maker n , is confronted with a choice among J alternatives. The decision maker obtains a defined utility or profit from each level of the alternatives thus, the utility that he/she (the decision maker) obtains from the levels of alternative $j = 1 \dots \dots J$. Here, the decision maker or the respondent obtains the highest utility from the alternative he chooses. The utility is known to him but not to the researcher. With these in mind, the behavioral model therefore is: to choose i if and only if $U_{ni} > U_{nj} \forall j \neq i$. Considering that though the researcher doesn't observe the respondent's utility but some of the attributes of the alternatives that the respondent faces, labeled $x_{nj} \forall j$, and some attributes of the attributes of the decision maker labeled s_n , the researcher therefore can specify these factors observed from the respondent to arrive at his utility. The utility is then denoted by $V_{nj} = V(x_{nj}, s_n) \forall j$. This form of utility function is often given the name, representative utility. Normally, V is dependent on parameters which are not known to the researcher and are statistically estimated. For the moment, this dependence is suppressed. $V_{nj} \neq U_{nj}$ since there remain aspects of the utility that the researcher does not observe. Now the utility is therefore disintegrated as $U_{nj} = V_{nj} + \varepsilon_{nj}$, where ε_{nj} , the error term captures the random factors affecting. The ε_{nj} is the difference between U_{nj} , the true utility and the part of the utility that is captured in V_{nj} hence the disintegration is fully general. Noting the characteristics of the error term such as its distribution depends on the specification of the researcher. That is, it is not defined by the choice situation but relative to the researcher's representation of that choice situation. The joint density of the random vector $\varepsilon_j = (\varepsilon_{ni}, \dots \dots \varepsilon_{nj})$ and denoted by $f(\varepsilon_j)$. Probabilistic statements can be made about the respondent's choice with this density. So, the probability that a respondent chooses alternative i is given by;

$$p_{ni} = \text{prob}(U_{ni} > V_{nj} \forall j \neq i)$$

$$p_{ni} = \text{prob}(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \forall j \neq i)$$

$$p_{ni} = \text{prob}(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \forall j \neq i) \dots \dots \dots (1)$$

The probability above is a cumulative distribution, that is, the probability that each random term $\varepsilon_{nj} - \varepsilon_{ni}$ is below the observed quantity. $V_{ni} - V_{nj}$.

The cumulative probability, considering the density function $f(\varepsilon)$ could be rewritten as;

$$p_{ni} = \text{prob}(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \forall j \neq i)$$

$$= \int \varepsilon I(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \forall j \neq i) f(\varepsilon) d\varepsilon \dots \dots \dots (2)$$

Where $I(.)$ is an indicator function and equals 1 when the expression in the bracket is true 0 otherwise. Various assumptions of the distribution from the unobserved part of the distribution can bring forth diverse discrete choice models. Most often in the fields of environmental, marketing and transportation economics, Conditional Logit model (CLM) is the most used specification. In as much the CLM is popular among researchers, it has a restrictive substitution pattern analogous to Independence of Irrelevant Alternative (IIA) property (Train, 1998; 1999). Conditional Logit regression is employed for the purpose of this work.

Conditional Logit regression is a specialized type of logistic regression often employed when case subjects with particular conditions or attributes are each matched with n controls subjects without the condition. McFadden (1973) proposed modelling expected utilities η_{ij} in terms of characteristics of the alternatives rather than the characteristics of the individuals. If z_{ij} represents a vector of attributes of the j th alternative, then, the model is postulated as;

$$\eta_{ij} = z'_{ij}\gamma \dots \dots \dots (3)$$

This model is thus called conditional logit model which turns out to be in equivalence with log-linear model where the main effects of the response is shown in terms of the covariates z_j . With J response categories, the response margin may be reproduced exactly using $J - 1$ linearly independent attributes of the choices.

Respondents' willingness to pay for insurance packages can then be estimated. The willingness to pay indicates in monetary terms how much price respondents are willing to pay or the cost

they are willing to incur in order to acquire an insurance package. Thus, following (Hanley, et al., (2002), WTP is denoted as;

$$WTP = b_y^{-1} [\ln \sum_i \exp(V_i^1) - \ln \sum_i \exp(V_i^0)] \dots \dots \dots (4)$$

Where V_i^0 is the initial utility while V_i^1 is the alternate utility and b_y is the marginal utility of income and attribute's cost. WTP also can also be measured as a ratio of coefficients. Hence,

$$WTP = - \frac{b_c}{b_y} \dots \dots \dots (5)$$

Where b_c is the coefficient of any of the other attributes and b_y is the price attribute.

2.3.2. Data Sampling

A questionnaire was designed to obtain information from coastal dwellers whose livelihoods are being threatened by sea level rise. The questionnaire covers subjects so as to estimate the WTP for interventions which would help reduce the impacts of sea level rise on their livelihoods, the estimation of total losses due to sea level rise; loss of livelihood, revenue and properties by their willingness to pay. This study makes use of survey data collected by author from four coastal towns in the Ketu South Municipality (KSM) and Keta Municipality (KM) the Volta Region of Ghana namely Adina, Amutinu, Selarkope and Kedzikope (KM). A sample of over 500 households were interviewed in total with the main focus on household heads. The sample size is chosen based the formular; $\frac{N}{1+e^2} = \frac{N}{1+0.05^2}$ (Bartlett, et al., 2001), where N is the population and e is the margin of error. This formular is repeated for all communities involved in the study. The population data on households and household heads was taken from the Ghana statistical service (GSS) specifically from the office of the GSS in volta region of Ghana, Ho. The population data was based on 2010 population census of Ghana however, adjusted to be a quasi-proxy for 2021 population using the annual population growth rate of the volta Region. This is because the 2021 population and housing data was not yet available at the time of the survey. The survey design was randomly targeted any households of the community. After the survey, about 517 respondents had responded to the questionnaire although the study looked forward to about 565 respondents. Furthermore, the data was cleaned based on the responses which came to about 423 respondents. In all 423 respondents were used for the analysis.

Generally, in response to the problems of climate change, policy makers agree on three policies such as; migration, adaptation, and compensation (Tigre, 2013). Insurance system could be seen as a way of adaptation. Many people today advocate for insurance as a coping mechanism tool for natural disasters. It is argued that beyond the provision of financial relief to victims, insurance could serve as incentive for preventive measures if rewards are given by insurers in the form of reduction in premiums to individuals for their efforts (Antwi-Boasiako, 2016). Thus, this study proposes the use of insurance systems to help solve the problems of sea level rise. Sea level rise could accelerate the gravity of storm-related flooding. Coastal flooding has been experienced at various places in the past and even recently very noticeably due to its impact on construction such as sea walls, houses near the shore and low-lying lands. In review of the impact of climate change on insurance, it has been predicted that there's going to be an increase in global catastrophic losses from the annual average estimate of around US\$20 billion to about US\$100 billion yearly in overall economic terms and even with this estimate, the potential longer-term consequences of climate change are not taken into account (Smith, 2013). Insurance is critical for recovery from disasters in coastal regions; providing financial debt-to-income requirements. Flood insurance is rare in most countries. Local business does not usually have insurances. Meanwhile, insurance is supposed to be a way of transferring risks. Households pay premiums every year so that in case of costly disasters, they may receive the needed funds to cover for damages (Kousky, et al., 2021). The minimization of risk and losses calls for actions from the state as well as victims and the financial sector, particularly, the insurance industry (Kron, 2009). Also, instead of waiting for solutions from government alone, individuals could insure themselves against the impacts from the risk of sea level rise. In theory, when a loss is somewhat inevitable, that loss is insurable under a commercial insurance contract. The event which is insured should have some level of uncertainty that is; whether it may happen or not or the number of times it may happen. Thus, uncertainty is a necessary legal requirement for a loss to be insured. Also, commercial respondents are asked few questions prior to the survey to have a gauge of their feeling toward this insurance program. From Kron (2009), there are three main types of floods which are, storm surges, river flood and flash flood. The storm surges take place along the coast and big lakes along sea coasts as well as coasts of big lakes. They have the greatest loss potential of water-related events for lives and property however, the presence of coastal defense reduces the frequency and intensity of losses.

Following the Lancaster (1966) approach to demand theory, the choice modelling insurance are disintegrated into a set of characteristics or attributes. There is a tendency to include all every possible alternative and all available attributes made in the choices established in the preference for the insurance scheme. However, various studies have agreed on the fact that a respondent's ability to choose between alternatives decreases as the number of alternatives increase (Siikamäki & Layton, 2007). In the simplest form, respondents are asked to choose between only two alternatives. While initially it might appear agreeable to make choices among a whole lot of alternatives, it is very exhaustive and difficult to understand (Egbedewe-Mondzodzo, et al., 2010). Respondents were presented with 4 choice sets showing 3 options of insurance packages in each choice set. The 3 attributes bordering these choice sets and choice packages are; Premium, Information and Claim while respondents are asked to make choices out of the options. The tradeoffs of respondents among the alternatives or packages are quantified using statistical techniques. These respondents are also asked questions to determine how realistic, plausible unbiased, understandable and sufficient the options in the questionnaire are.

First of all, this flood insurance is drawing on the national flood insurance program in the USA (NFIP) (FEMA, 2021). Five insurance premiums were picked from the national insurance program based on the lowest hit areas in the scheme in terms of intensity of floods. The lowest hit areas (\$663, \$618, \$616 and \$592) were picked because the intensity of the flood here in Ghana is supposed not to be high as the high flood intensity areas in the USA. These amounts were so as at November 2021. Adjustments were made to the premiums based on the 2020 power purchasing parity of Ghana which was 2.3 LCU per international dollars. Dividing the amounts in dollars by 2.3 (purchasing power parity of Ghana at 2020), the new amounts became (288.26, 268.70, 267.83, 275.39 all in Ghana cedis). Now these figures seem closer to one another thus, by intuition and cognitive thinking, these amounts are modified into (200, 250, 300 and 350 all in Ghana cedis). Notably, these amounts represent the insurance premiums that the households in the affected areas are supposed to pay annually in order to have access to some claims when there's is flood which affect their livelihood. In order to get the claims which households are liable to in case of flood, the various premiums are divided by a representative rate of 0.225%. This rate is taken from the National Insurance Commission (NIC) of Ghana standard ratings under the commercial property, Industrial property and manufacturing class of risks. Dividing the various premiums by this rate, the various claims therefore become

approximately; 88,889, 111,111, 133,333 and 155,556 Ghana cedis respectively. However, the claims were rounded to the nearest hundred thousand thus; 90, 000, 110, 000, 130, 000 and 160, 000 all in Ghana cedis respectively. Having obtained the various premiums and claims, reception of information is also added as another attribute of the insurance policy. Therefore, the insurance package includes, payment of premiums, receiving information (yes or no) and receiving claims also claims of various amount in Ghana Cedis

Table 6. Attributes, Description and Levels of Packages

Attribute	Description	Levels
Premiums (GHC)	200; 250; 300; 350	4
Information	Yes or No	2
Claims (GHC)	90,000,110,000;130,000;160,000	4

These attributes, descriptions and levels were keyed into the SAS JMP software to generate 8 choice sets out from which 4 choice sets were chosen for the study. These 4 choice sets have 3 choices each thus, totaling to 12 choice of insurance packages in all. The various insurance packages in the choice include;

Table 7. Choice Set 1

Attribute	Package 1	Package 2	Package 3
Premium	350	300	0
Information	Yes	No	No
Claim	110000	160000	0

Table 8. Choice Set 2

Attribute	Package 4	Package 5	Package 6
Premium	250	200	0
Information	No	Yes	No
Claim	130000	110000	0

Table 9. Choice Set 3

Attribute	Package 7	Package 8	Package 9
Premium	250	300	0
Information	No	Yes	No
Claim	160000	130000	0

Table 10. Choice Set 4

Attribute	Package 10	Package 11	Package 12
Premium	200	350	0
Information	No	Yes	No
Claim	90000	160000	0

These choice sets above were presented to respondents to make a choice from each and so in all, each respondent had four choices coming from different choice set. The reason for different choice sets is to ensure consistency.

2.3.2. Variables

Table 11. Variable Description.

Variables	Description
Choice	The choices the respondents made for the various insurance packages, to choose or not (Dummy= 0 for not and 1 for a choice)
Premium	The premium payments for the various insurance packages (0, 200, 250, 300, 350 all in Ghana Cedis)
Information	Depending on the packages respondents choose, they may or may not receive information about tidal ways prior to it happening, (Dummy= 0 for no information and 1 for Yes information)
Claim	The claim victims are entitled to from the various insurance packages when floods destroy their properties (0, 90000, 110000, 130000, 160000)
Age	Age of respondents in years
Gender	The Gender of the respondent, Male or female (Dummy= 0 for Female and 1 for Male)
Edu2	The Education status of the respondent; formal education or not (Dummy= 0 for no formal education and 1 for formal education)
NewMaritalStatus	The marital status of the respondent, whether married or not (0 for single and 1 for Married)
workdays	The number of days in a week the respondent works
workhours	The number of hours in a day the respondent works
HHnum	The number of people in the household
Fishingactivities	Whether the respondent engages in fishing activities, Yes or No (Dummy= 0 for No and 1 for Yes)
Saltminingactivities	Whether the respondent engages in salt mining activities, Yes or No (Dummy= 0 for No and 1 for Yes)
Otherlivelih	Whether the respondent engages in other livelihood options other than Fishing activities and salt mining activities, Yes or No (dummy= 0 for No and 1 for yes)
Annual Income	The annual income of respondents in Ghana Cedis
SLRKnow	Knowledge of sea level rise, Yes or No (Dummy =0 for No and 1 for Yes)
SLRCope	Whether the respondent is able to cope with the rise in sea levels, Yes or No (Dummy= 0 for no and 1 for Yes)
SLREffect	Whether the respondent is affected by sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
SLRPropLoss	Whether the respondent has lost properties due to sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
SLRDisplace	Whether the respondent has been displaced due to sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
IncDecrease	Whether respondents have experienced a decrease in Income (Dummy= 0 for No and 1 for Yes)
GovtHp	Whether respondents have received from the government or not (Dummy= 0 for No and 1 for Yes)
NGOandPri	Whether respondents have received from NGOs and or Private people or not (Dummy= 0 for No and 1 for Yes)
FamHp	Whether respondents have received help from family members other family members or not (Dummy= 0 for No and 1 for Yes)

2.3.3. Respondents Characteristics

The survey results for personal, economic and social characteristics of respondents are shown in the Table 12. The results of the questionnaire distributed for the study showed an average age of approximately 48 years while about 44% of these respondents are females and about 56% are males. Also, concerning educational status, almost 41% of the respondents have no formal education, about 46% have primary education and about 11% with secondary education while less than a percentage have tertiary education. The average family size of respondents is approximately 7 people. Averagely, respondents work approximately 6 days in a week and 10 hours in a day. Again, with respect to the livelihood options, most of the respondents are involved in fishing activities. For instance, about 69% of the respondents are involved fishing activities only, 6% are involved in fishing activities and other activities, less than 1% involved in fishing activities, salt mining activities and other activities. Furthermore, salt mining comes as another livelihood option respondents are involved in. About 3% are involved in just salt mining activities while about 8% are involved in both salt mining and fishing activities while approximately 1% is involved in salt mining activities and other activities. Lastly, 12% of the respondents are involved in other activities other than either fishing activities and salt mining activities. The fishing activities include mainly; fishing (beach seine, pair seine, toga and poly fishing), fish monging as well as selling and buying of fish among others. On the side of salting, the main activities are; mining of salt, buying and selling of salt and laborer working. With respect to the respondents involved in other activities, most of them are petty traders (selling food stuff, selling cooked food, operating drinking bars), carpentry, driving among others. Averagely, respondents receive an income of GHC 6259 annually. When questions were asked about whether they receive relief items when there's coastal flooding from government, NGOs and family members, about 41% of them respond that they have received mainly items in the form of food, shelter items other items from the government. About 33% have received these same items from NGOs and private people while only about 18% have received help from family members.

Table 12. Descriptive Statistics of respondents' characteristics

Respondents' Characteristics	Mean	Standard Deviation	Min	Max
Age	48.300	12.759	20	90
GenderD	0.558	0.497	0	1
Edu2	0.587	0.492	0	1
NewMaritalStatus	0.650	0.477	0	1
workdays	5.846	0.688	1	7
workhours	10.458	2.627	1	24
HHnum	7.329	3.817	1	27
Fishingactivities	0.832	0.374	0	1
Saltminingactivities	0.132	0.339	0	1
Otherlivelih	0.200	0.400	0	1
Annual Income	6258.719	2978.836	2550	10000
AdinaTown	0.490	0.501	0	1
AmutinuTown	0.225	0.418	0	1
KedzikopeTown	0.185	0.389	0	1
SelakorpeTown	0.097	0.297	0	1
GPSLongs	1.055	0.034	0.984	1.189

Figure 13. depicts the effects of sea level rise, that is whether respondents are being affected by the rise in sea levels in the form of flooding or not. The graph shows that about 89.1% percent are being affected by sea level rise induced flooding. Out of the respondents who responded to the questionnaire, about 91.9% of males are affected as against 8.1% of males who are not affected. Furthermore, 84.6% of female respondents responded in the affirmative as against 14.4% who responded otherwise. Both male and female household heads experience effects from sea level rise however, a higher percentage of men affected as compared to the percentage of women who are affected. Again, asking how respondents are affected, Figure 14. demonstrates that 57.4% of household heads interviewed have lost properties as against 42.6% household heads who have not lost any properties. These properties that respondents have lost include; houses, lands working equipment among others. Also, among respondents who have lost properties due to climate-induced flooding, approximately 66% of males responded that they have lost properties while approximately 34% of male household heads have not. With respect to females, approximately 53% of them have lost properties while approximately 47% have not.

With regards to displacement as a result of sea level rise, Figure 15. shows that more than half of respondents (54.4%) have ever been displaced with sea level rise being the reason. Notedly, when they are displaced, they move to nearby communities who are also experiencing flooding

due to the rise in sea levels as well and the problem is never resolved. Going more detailed, higher percentage of female headed households are displaced (54.6%) as against about 44.4 % of female headed households who are not displaced. Additionally, about 53.4% of male headed households have been displaced due to flood whereas 46.6% of male headed household have not been displaced. Here, the analysis from the graph is that more female headed households are displaced more than their male counterparts. Respondents again were asked if they have lost some income due to the floods from the rise in sea levels. From Figure 16. almost all respondents (98.3%) have experienced decrease in their income thanks to climate-induced flooding. More specifically, 98.7% of male respondents responded in the affirmative while just about 1.3% percent responded otherwise. Again, 97.8% of female counterparts said they experienced decrease in income by reason of sea level rise while 2.2% of female respondents said they have not. It can be inferred almost all females and males alike are losing income due to climate induced sea level rise.

According to the National Organization of Disaster Management (NADMO) and the Ghana Statistical Service (GSS) interviewed, relieve items from the government are given to victims when there is a storm surge inducing flooding. These items include more often, food items as well as shelter items to which some respondents confirmed as having received them. From Figure 17., respondents have received support in the form food items, shelter and money from the government. There are people who have only receive one form of support whereas there are some who have received more than one form of support from the government. The diagram portrays that about 93% of respondents have received both food items and shelter items, followed by 2.9% who have received money, food items as well as shelter items. 2.3% of respondents also said they have received just shelter items only. Generally, it can be inferred that, flood victims receive shelter items and food items from the government as support.

Again, respondents acknowledge support received from Non-Governmental Organizations (NGOs) as well as private people. These forms of support include mainly food items and shelter items in the same way as the government support. Figure 18. shows that 93.4% of respondents acknowledge receipt of both food items and shelter items while 2.9% of the respondents have received shelter items with just about 1.5% of respondents receiving food items from these

η_i represents the utility one derives from a given insurance package with its attributes. Premium denotes the annual cost of buying an insurance package. Also, information indicates whether a respondent may have a prior to flooding, 0 for no information and 1 otherwise. Finally, Claim denotes the amount of money to be received incase respondent is affected by flood. Following (Kwak, et al., 2016; Ali, et al., 2020), this study interacts socio-economic characteristics of with attributes specifically, premium and claim in order to specify the model with observed heterogeneity. The equation (1) above is estimated using the conditional logit estimation model (Shi & Yin, 2018).

2.4.1. Econometric Estimation willingness to Pay for insurance packages

The study employs choice modelling method in exploring the willingness to pay for insurance packages. Instead of respondents stating the amount they are willing to pay, they are rather presented with four different choice sets with 3 insurance packages in each choice sets where respondents could make a choice in each choice set. The conditional logit econometric model is then employed to analyze the choices. It should be noted that the characteristics of the individuals were interacted with the attributes of the insurance packages for the analysis in order to have a within group variance.

2.4.1a. Estimates of Conditional Logit Regression for all respondents

Table 13. Conditional Logit Estimation for all respondents

VARIABLES	Variables With Premiums as		Variables With Claims as		Variables With Both Premiums and Claims as	
	Interaction	Standard Errors	Interaction	Standard Errors	Interaction	Standard Errors
Choice						
<i>Choice Attributes</i>						
	-		-		-	
PremiumperTh	22.294***	(-2.182)	19.191***	(-1.119)	23.365***	(-1.626)
ClaimperMil	20.482***	(-2.1)	13.802***	(-4.66)	22.218***	(-4.321)
Information	3.547***	(-0.143)	3.586***	(-0.144)	3.573***	(-0.144)
<i>Respondents' Characteristics</i>						
Gender	1.195***	(-0.417)	2.535***	(-0.956)	1.147***	(-0.414)
Edu	0.442	(-0.387)	1.148	(-0.892)	0.412	(-0.386)
Fishingactivities	1.061	(-0.75)	1.89	(-1.713)	1.103	(-0.746)
Saltminingactivities	0.325	(-0.641)	0.389	(-1.473)	0.293	(-0.638)
Otherlivelih	-0.026	(-0.692)	-0.293	(-1.593)	0.018	(-0.687)
<i>Others</i>						
SLRKnow	2.427***	(-0.8)	4.922***	(-1.784)	2.502***	(-0.798)
SLRCope*	6.088***	(-1.18)	13.736***	(-2.734)	13.903***	(-2.728)
SLREffects*	0.117	(-0.624)	0.336	(-1.427)	0.43	(-1.427)
SLRPrLoss*	-0.422	(-0.46)	-1.193	(-1.056)	-1.479	(-1.051)
SLRDisplace*	1.116***	(-0.423)	2.244**	(-0.977)	2.152**	(-0.975)
IncDecrease*	-1.75	(-1.508)	-3.127	(-3.449)	-3.472	(-3.461)
GovHp	-0.353	(-0.549)	-0.674	(-1.264)	-0.248	(-0.546)
NGOPrHp	0.354	(-0.597)	0.217	(-1.373)	0.405	(-0.593)
FamHp	-0.594	(-0.537)	-1.49	(-1.221)	-0.587	(-0.534)
Observations	4845		4845		4845	
Prob > chi2	0.0000		0.0000		0.0000	
LR chi2(17)	1215.49		1209.38		1211.44	
Pseudo R2	0.3425		0.3408		0.3414	

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 13. shows the results of the conditional logit estimation of the choices respondents made as far as the insurance packages are concerned. The result in column 2 represents the estimation where all the variables that represent the characteristics of respondents except their ages are interacted with premium which is an attribute of the choices. It must be noted that in order to

avoid huge standard errors premiums are divided by 1000 thus, we have premium in thousand Ghana Cedis or per thousand Ghana Cedis. Also, claim as an attribute of the choice packages is divided by 1,000,000 thus, we have claim in 1million Ghana Cedis or claim per thousand Ghana Cedis. The result in the first column of table 0.9 shows that respondents based their choices on the attributes of the choice packages. For instance, the higher the price of the premium the less people are willing to pay for the insurances packages or make choices. This is in line with the law of demand which states that, there is an inverse relationship between price and quantity demanded. With regards to information, the more people are given information about storm surges the more they are willing to pay for the packages. Intuitively, this is reasonable as individuals would be able to ascertain that they have prior information to a disaster rather than being consumed suddenly. They would rather pay for such information in order to prevent damages and calamities. For claims as attribute of the choice insurance packages, there is a direct relationship in its relation with choice. The more the insurance package is associated with more claims, the more people are willing to go for it. This is in line with the “more is preferred to less” assumption of the theory of the consumer.

Moving on to the characteristics of the respondents interacted with premium, Column 2 again shows that gender is positively significantly related to making a choice of insurance package. That is, men are more willing to choose an insurance packaged as compared to being a woman. Also, the result shows that, the more people know about sea level rise or is aware of the coastal flooding the more they are willing to make a choice of an insurance package. Moreover, the more respondents are displaced the more they are willing to choose insurance packages. However, the ability to cope with sea level rise is positively related to making choices and significant as well. One would have thought that the more people are able to cope with the rising sea level, the less they will be willing to make choices regarding insurance packages. Nevertheless, it may be explained by the that perhaps their coping ability in comparison to the gains of insurance packages is less thus they would rather buy insurance packages rather than relying on own coping capability strategy.

Furthermore, the results in the 4th column shows the conditional logit regression where the characteristics of the respondents are interacted with claims which are attributes of the insurance packages. The result is similar to the result of column 2. Here also, making a choice is

significantly influenced by all the three attributes of the packages with the expected signs. Regarding the respondents' characteristics, being a man positively influences the choice of packages as compared to being a woman. Knowing also about sea level rise does positively affect a respondent's decision making as much being displaced does. Then, the more one is able to cope with sea level rise, the more the person is willing to make a choice just as in the case of the result shown in column 2. Moving forward, column 6 shows the result of the conditional logit estimates where the characteristics of respondents are interacted with both premiums and claims. Here, all the individual characteristics are interacted with premium except the variables which represent, coping capability, being affected by sea level rise, losing properties as a result of sea level rise, being displaced as a result of sea level rise and reduction in income as a result of sea level rise which are being interacted with claim rather. The result here is similar to the 1st and 2nd results in column 2 and column 4. It can there be said that irrespective of the chosen interaction variable, the characteristics of the individuals have the same influence on the choice of package.

2.4.1b. Estimates of Conditional Logit Regression for Females Only

In table 0.10, results of the conditional logit regression of the respondents who are females are recorded. Here, the responses given by the male respondents are dropped in order to ascertain if there is a significant difference between decision to make a choice between females and males. Results from the 2nd column of the table shows the regression estimates when premiums are interacted with respondents' characteristics.

Table 14. Conditional Logit Estimation for females only

VARIABLES	Variables Interacted with Premiums		Variables Interacted with Claims		Variables Interacted with Both Premiums and Claims	
	Standard Errors	Standard Errors	Standard Errors	Standard Errors	Standard Errors	Standard Errors
Choice						
<i>Package Attributes</i>						
PremiumperTh	23.535***	(-3.104)	21.579***	(-1.811)	25.118***	(-2.498)
ClaimperMil	22.409***	(-3.444)	18.659***	(-6.511)	25.629***	(-6.19)
Information	3.846***	(-0.237)	3.898***	(-0.239)	3.871***	(-0.238)
<i>Respondents' Characteristics</i>						
Edu	0.79	(-0.62)	1.9	(-1.412)	0.721	(-0.615)
Fishingactivities	0.261	(-1.004)	-0.053	(-2.267)	0.317	(-0.993)
SaltMiningactivities	-1.09	(-0.78)	-2.729	(-1.785)	-1.112	(-0.776)
Otherlivelih	-1.758*	(-1.041)	-4.263*	(-2.357)	-1.700*	(-1.026)
<i>Others</i>						
SLRKnow	3.999***	(-1.154)	8.229***	(-2.514)	4.080***	(-1.154)
SLRCope*	5.640***	(-1.531)	12.041***	(-3.57)	12.362***	(-3.566)
SLREffects*	0.465	(-0.898)	1.279	(-2.039)	1.287	(-2.043)
SLRPrLoss*	-0.772	(-0.735)	-1.882	(-1.67)	-2.079	(-1.669)
SLRDisplace*	1.688**	(-0.721)	3.242**	(-1.652)	2.991*	(-1.651)
IncDecrease*	-2.745	(-2.011)	-5.45	(-4.584)	-5.961	(-4.61)
GovHp	-1.617*	(-0.868)	-3.779*	(-1.974)	-1.574*	(-0.862)
NGOandPri	1.534*	(-0.898)	3.013	(-2.053)	1.650*	(-0.891)
FamHp	-0.61	(-0.772)	-1.232	(-1.732)	-0.627	(-0.768)
Observations	2,100		2,100		2,100	
Prob > chi2	0.000		0.0000		0.0000	
LR chi2(16)	609.66		602.73		605.41	
Pseudo R2	0.3964		0.3919		0.3936	

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Column 2 of table 14 shows that all the 3 attributes of the choice packages have with the right signs when it comes to making a choice of an insurance package. The higher the premium, the less women are willing to make a choice. Also, the more women are certain of getting information about storm surges prior to their happenings, the more they would make choices and the higher the claims the more respondents would make choices as well. These results show that

the respondents are rational in their choice making. Women engaged in other livelihood activities are not willing to choose insurance packages. This may be due to the fact that their livelihoods or activities are not so much affected thus, their unwillingness to choose insurance packages. The knowledge that sea level rise is happening and the ability to cope with sea level rise also positively influence women's decision to make choices just as in the regression results from Table 2.3. Again, if women are displaced by sea level rise, then they are willing to make choices of the insurance packages. The results also shows that as women receive help from the government, they would not be willing to choose from insurance packages. It is a little surprising that the help from NGOs and private people negatively affect the choice of insurance packages such that, the more women respondents receive from NGOs and private people, the less they are willing to choose an insurance package.

Concerning the results in the 4th column where claims are used as interaction terms, the results are similar to the results where premiums are used as the interaction terms. choose an insurance package.

2.4.1c. Estimates of Conditional Logit Regression for Male Only

In table 0.11, results of the conditional logit regression of the respondents who are males are recorded. Here also, the responses given by the female respondents are dropped in order to ascertain that there is a significant difference between decision to make a choice between females and males. Results from the 2nd column of the table shows the regression estimates with premium as the interacting with respondents' characteristics.

Table 15. Conditional Logit Regression Estimates for Male Only.

VARIABLES	Variables Interacted with Premium		Variables Interacted with Claim		Variables interacted with both Premium and Claim	
	Standard Errors		Standard Errors		Standard Errors	
Choice						
<i>Package Attributes</i>						
PremiumperTh	19.436***	(-3.381)	17.785***	(-1.445)	20.109***	(-2.289)
ClaimperMil	19.763***	(-2.693)	15.005**	(-7.437)	19.335***	(-6.468)
Information	3.379***	(-0.181)	3.427***	-0.183	3.411***	(-0.183)
<i>Respondents' Characteristics</i>						
Edu	0.008	(-0.521)	0.122	(-1.206)	-0.004	(-0.519)
Fishingactivities	1.742	(-1.31)	4.009	(-3.035)	1.829	(-1.305)
Saltminingactivities	4.526***	(-1.542)	9.824***	(-3.574)	4.514***	(-1.539)
OtherLivelihood	1.740*	(-1.008)	3.919*	-2.354	1.806*	(-1.004)
<i>Others</i>						
SLRKnow	-0.007	(-1.256)	-0.387	(-2.883)	0.153	(-1.25)
SLRCope*	7.573***	(-2.261)	17.843***	(-4.979)	18.061***	(-5.033)
SLREffects*	-0.206	(-0.891)	-0.634	(-2.058)	-0.458	(-2.055)
SLRPrLoss*	-0.267	(-0.622)	-0.936	(-1.439)	-1.275	(-1.428)
SLRDisplace*	0.688	(-0.55)	1.391	(-1.272)	1.422	(-1.267)
IncDecrease*	-0.71	(-2.432)	-0.222	(-5.528)	-0.256	(-5.516)
GovHp	1.083	(-0.775)	2.818	(-1.803)	1.208	(-0.77)
NGOandPri	-1.534*	(-0.87)	-4.078**	(-2.013)	-1.491*	(-0.866)
FamHp	-0.272	(-0.791)	-1.193	(-1.819)	-0.227	(-0.787)
Observations	2,745		2,745		2,745	
Prob > chi2	0.0000		0.0000		0.0000	
LR chi2(16)	643.05		643.14		643.26	
Pseudo R2	0.3199		0.3199		0.3200	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Column 2 of table 15 shows that all the 3 attributes of the choice of packages have with the right signs when it comes to making a choice of an insurance package. The higher the premium, the less men are willing to make a choice. Also, the more men are certain of getting information about storm surges prior to their happenings, the more they would make choices and the higher the claims the more respondents would make choices as well. Regarding the characteristics of respondents, being a man involved in salt mining activities affects positively the decision to

choose an insurance package unlike in the regression for the female respondents and the regression with both females and males where the variable was negative and positive respectively but not significant. Male respondents who engage in other activities are more likely to make choice unlike their female counterparts who would rather not make a choice of insurance package. In this regression also, the ability to cope with sea level rise has a positive influence on choice in the same way as occurred in the regression where male respondents were dropped and the estimates which include both male and female respondents. Receiving help from NGOs and private has negatively relationship on choice unlike the regression for the females where the variable is positive and significant as well. It is not wrong therefore to imply that the more males are helped by NGOs and private people the less they care about making choices as compared to their female counterparts. In the case of help received from the government in this regression, the variable is not significant. It is however significant and negative in the regression with only female respondents.

Moving on to column 4 where claim attribute variable is used to interact with the variables that portray the characteristics of the respondents, the result is not significantly different from the result in the 2nd column where the interaction variable is premium. The variables in both situations have common variables that are significant and have the same signs as well. In column 6 where both premium and claim are used as interaction terms, the result is not significantly different from the 2nd column where only premium is used as the interaction variable. In all the three cases, the same variables are significant with the same signs. This implies that the changes are as a result of the differences in individual characteristics and not their interaction with attributes of the insurance packages.

2.4.2. Estimating willingness to pay

In calculating for the willingness to pay for the insurance packages, inclusion of the price proxy (premium) allows for the estimation of the monetary value of attributes of the insurance, that is, how much premium respondent to pay to experience the other attributes of the packages. This is calculated as the change in the other attribute over the change in the premium. This is shown as;

$$-\frac{\partial y}{\partial x} = -\frac{\partial(\text{other attribute})}{\partial(\text{price})} = -\frac{\beta_2}{\beta_1} = \frac{\text{Claim}}{\text{Premium}} \text{ and or } \frac{\text{Information}}{\text{Premium}}$$

2.4.2a. *Estimates of Willingness to pay for all Respondents*

Thus, the willingness to pay for the premium as well as the other attributes for the insurance packages (Information and Claim) for all respondents is presented in table 16.

Table 16. Willingness to pay for insurance packages for all respondents.

Attribute	Willingness to pay (in thousand GHC)	Standard Error	Confidence Interval
Information	.1881789	.0081804	[.1721455 .2042123]
Claim	1.025875	.0578731	[.912446 1.139304]

The results in Table 16 infers that, respondents are willing to pay approximately 188 Ghana Cedis annually for an insurance package base on the reception of information prior to storm surges. Similarly, based on the claim attribute, respondents are willing to pay approximately 1,026 Ghana cedis for insurance packages that includes a positive claim. As long as these results shows that they are willing to pay something in order to deal with the problems of sea level rise, the implication is that they are being affected and that the cost of sea level rise is not far from their willingness to pay.

Table 17. Willingness to pay for various packages

Packages	Premium in Thousand Ghana Cedis	Information	Claim in Thousand Ghana Cedis	WTP in Thousand Ghana Cedis
Package 1	0.35	1	0.11	0.30103
Package 2	0.3	0	0.16	0.16414
Package 3	0	0	0	0
Package 4	0.25	0	0.13	0.13336
Package 5	0.2	1	0.11	0.30103
Package 6	0	0	0	0
Package 7	0.25	0	0.16	0.16414
Package 8	0.3	1	0.13	0.32154
Package 9	0	0	0	0
Package 10	0.2	0	0.09	0.09233
Package 11	0.35	1	0.16	0.35232
Package 12	0	0	0	0

The table 17., shows the willingness to pay of various packages at various prices. It can be inferred that generally, the willingness to pay are quite lower than the market prices. For instance, the average willingness to pay for package 1 is approximately 301 Ghana Cedis while the market price for package 1 is 350 Ghana Cedis all in thousand Ghana Cedis. Also, The average willingness to pay for package 2 is 164 Ghana Cedis while the market price is 300 GhC. However, there are a few packages with their average willingness to pay are higher than the market prices. For instance, package 8 has an average willingness to pay of 321 GhC while its market price is 300 GhC which the difference is not so huge. Again, with package 5 has the average willingness to pay to be approximately 301GhC where as the market price is 200GhC which constitutes a huge gap between the willingness to pay and the market price. One observable thing is that, packages whose willingness to pay are higher than their market prices have information. Surprisingly,

those packages have relatively lower claims. That is, in those packages, respondents are liable to information to storm surges prior to their happening. This indicates that respondents have a very high utility for information and they are willing to pay a lot for it even more than the claims. Furthermore, the total average willingness to pay which is calculated as the sum of the various willingness to pay for the various prices is approximately 1,830 Ghana Cedis. Multiplying this amount by the total population of the case study area which is 1,469 households, the total willingness to pay for the entire case study area becomes, 2,688,270 Ghana Cedis. Since this study is estimating the cost of sea level rise by the total willingness to pay, the cost therefore is 2,688,270 GhC.

Figure 21. shows the average marginal effects of choice based on attributes of the insurance packages. It is clearly seen from the graph that the changes in choices is largely based on changes in claim gains then followed by information and then, premium. This reveals that changes in choice are more affected by changes in claim more than the other attributes. Respondents are more influenced to choosing a package based on the claim they will receive when there's a disaster. However, they are least affected to make a choice of an insurance package based on the premium of the insurance.

2.4.2b. Estimates of Willingness to pay for Males

Again, the willingness to pay for insurance packages among genders (male and female) were estimated to decipher if there is a significant difference in their willingness to pay for insurance packages and consequently if there is also significant difference in the amount of cost, they bear due to sea level rise. Thus, the willingness to pay for the premium for male respondents presented in table 18.

Table 18. Willingness to pay for insurance packages for male respondents only.

Attribute	Willingness to Pay in Thousand GHC	Standard Error	Interval
Information	.189384	.011139	.1675521 .211216
Claim	1.103058	.0744867	.9570666 1.249049

The results in Table 18 infers that, male respondents are willing to pay approximately 189 Ghana Cedis annually for an insurance package based on the reception of information prior to storm surges. Similarly, based on the claim attribute, these are willing to pay approximately 1,103 Ghana cedis for insurance packages that include payment of a premium. These figures of willingness to pay are a bit higher than when both males and female respondents were combined. In comparison in both cases, men are willing to pay more on the average annually for insurance packages even more than the total average annually hence, the implication is that men are affected more.

Figure 22. shows the average marginal effects of choice based on attributes of the insurance packages for male respondents only. It can clearly be seen from the graph that the changes in choices is largely based on changes in claim gains then followed by information and then, premium. This reveals that changes in choice are more affected by changes in claims more than the other attributes. Male respondents are more influenced to choosing a package based on the claim they will receive when there's a disaster. This result from the graph is not statistically different from the results that concerns both genders.

2.4.2c. Estimates of Willingness to pay for Females

In the bid to find out differences between male and female respondents in terms of their willingness to pay for premiums, the study went ahead to estimate the willingness to pay for insurance premiums for only female respondents. Thus, the willingness to pay for the premium for male respondents presented in table 19.

Table 19. Willingness to pay for insurance packages for female respondents only

Attributes	Willingness to Pay in Thousand Ghana Cedis	Standard Error	Intervals
Information	.1893378	.0125083	.1648219 .2138536
Claim	.9263706	.0931238	.7438513 1.10889

The results in Table 19 infers that, female respondents are willing to pay approximately 189 Ghana Cedis annually for an insurance package based on the reception of information prior to

storm surges. Similarly, based on the claim attribute, women are willing to pay approximately 926 Ghana cedis for insurance packages. These estimates of willingness to pay for premium based information for female respondents is approximately the same as that for the males and just higher than both combined. Further, the willingness to pay for premium based on claim is lower than that of males and that of both males and females combined.

Figure 23. shows the average marginal effects of choice based on attributes of the insurance packages for female respondents only. It is seen from the graph that the changes in choices is largely based on changes in claim gains then followed by information and then, premium. This reveals that changes in choices are mostly affected by changes in claim more than the other attributes. Female respondents are more influenced to choosing a package based on the claim they will receive when there's a disaster. This result from the graph is not statistically different from the results that concerns both genders and even only males as well.

The perspective of this study is to estimate the cost of sea level rise using the willingness to pay approach. Usually, when victims are told to estimate their costs, they tend to over-estimate or under estimate however this approach reduces the inefficiencies. In realizing this objective, the limitation was finding accurate insurance premiums and claims since at present, there are no stand-alone flood insurance policies in Ghana to be modelled on. Again, respondents lack enough knowledge on how insurance works thus, convincing them to partake in the survey was difficult. Also, in terms of population data, it is difficult to get data on rural households of which to draw sample from making it difficult to estimate samples. Lastly, for some respondents, it was realized that the choices of insurance packages were not consistent across the various choice sets.

2.5. Conclusion and Recommendations

This study set out to Estimate the cost of sea level rise to coastal livelihood. Specifically, the study sought to evaluate the factors that affect the choice of an insurance package as well as to estimate the potential amount that coastal dwellers are willing to pay for potential insurance packages. From the various analysis, both econometric and non-econometric have shown that people who live in coastal region are being affected by the rising of sea levels. These confirm literature about sea level rise affecting people from the coast region (Addo & Adeyemi, 2013; Dampha, 2020). The effect experienced leads to people finding solutions or ways to cope with

the effects thus, this study seeking to find a way to this problem came up with insurance package to see if respondents would be interested. Evaluating the factors that affect the decision to make a choice or not, it was found out that, all the attributes of the insurance packages are influential to choosing a package or not. Therefore, the higher the premium of an insurance package, people would not like to choose the package. This is in accordance with the law of demand where the higher the price, the less the demand. Also, when there is assurance of information about storm surges prior to their happening, people are very willing to choose the insurance package. Claim as an attribute has a positive significant relationship with people choosing a package or not. The higher the claim, the more people are willing to choose it rather a package with less claim. Furthermore, respondents' characteristics were interacted with attributes of the insurance packages just as in (Ali, et al., 2020). The results showed that Gender, Knowledge of sea level rise, ability to cope with sea level rise and being displaced by sea level rise affect one's decision to choose an insurance package or not. Men are likely to choose an insurance package as compared to women. In addition, knowing or being aware of sea level rise make people want to choose an insurance package as compared to not being aware. Being displaced by sea level rise also makes an individual want to choose an insurance package. However, it is interesting to realize the more people are able to cope with sea level rise, the more they would want to choose an insurance package.

Moving forward, the study sought to decipher if there are differences between men and women in terms of factors that affect their choices. The results showed in both cases that all the attributes of the insurance package are significant as it is in the case of the regression where both genders were included. Also in both cases, it was found that knowledge of sea level rise, coping capability as wells as being displaced are significant with the same signs and also similar to the regression with without gender distinction. However, concerning variables that represent the effect of help given by government and NGOs or private persons, the study recorded some differences between the regression for men and the regression for women. The results for the women depict that the help from government influences the decision to choose an insurance package negatively whiles the support received from NGOs and private person impacts positively the decision to choose an insurance package. On the other hand, the choice of an insurance package for a male respondent is not influenced by the help from the government however, the support from NGOs and private persons influences the choice of an insurance

package negatively for male respondents. With regards to the results without distinction in gender, both the support from government and the support from NGOs and private persons do not have significant impact on choice. Generally, the decision of a respondent to make choice or to choose an insurance package is based on the attributes of the package (premium, information and claim) as well as the gender, awareness of sea level rise, coping capability and displacement.

The study again found that respondents are willing to pay for insurance packages as a way to cope with the effects of sea level rise. For the estimation of willingness to pay, the study found that the willingness to pay for all respondents bases on information as an attribute of insurance is approximately GHC 189 while the willingness to pay for premium based on claim is approximately GHC 1,025. These show that claim has a higher influence on the willingness to pay more than information. Again, calculating the willingness to pay, it was found that generally, the willingness to pay for various packages is lower than their market prices even though there are few packages where respondents have higher willingness to pay as compared to their market prices. The estimated average total willingness to pay for all the packages is 1.830 thousand cedis and the total willingness to pay for the total population of the study area is 2,688,270 Ghana Cedis. Notedly, this study proxies cost by willingness to pay thus, the total estimated cost of the study area is 2,688,270 Ghana Cedis. The study also made distinction between male and female respondents regarding their willingness to pay for insurance packages. For males, the willingness to pay based on information is about GHC 883 while the willingness to pay based on claim is about GHC 1,103. For females, the willingness to pay based on information is about GHC 189 while the willingness to pay based on claim is about GHC 926. It can be concluded that based on information, the willingness to pay for both males and females is similar nonetheless, based on claim, the willingness to pay for men is higher than that of women. In essence men are willing to pay higher premiums for insurance packages as compared to women.

Finally, the study recommends that the government and respective authorities be keen on the effects that costal dwellers face in the light of sea level rise. These authorities can consider an insurance package proposal like this to help the coastal region cope with rising sea levels especially when most of them are not willing to change livelihoods or place of abode. There hardly exist stand-alone flood insurance policies in almost all west African countries thus, considering that could be a step in the right direction to mitigate the impact of climate change on

coastal dwellers. The limitation to this study centers on the challenge of finding accurate insurance premiums and claims since at present, there are no stand-alone flood insurance policies in Ghana to be modelled on. Again, the issue of respondents lacking enough knowledge on how insurance works thus, convincing them to partake in the survey was difficult. Also in terms of population data, it is difficult to get data on rural households of which to draw sample from making it difficult to estimate samples. Lastly, the challenge of inconsistencies in choices across the various choice sets was a problem.

ESSAY 3. Analyzing the vulnerability to poverty as a result of sea level rise

3.1. Introduction

Climate change is one of the biggest threats to development today which affects the poor and vulnerable disproportionately (Chaudhury, 2017). The number of poor people in both developed and less developed countries is expected to increase by 2100 putting sustainable development at risk (IPCC, 2015). Climate change impacts are severe and have cumulative effects on natural and managed systems across sectors (IPCC, 1997). Although the impacts of climate change are characterized by heterogeneity across countries, there's now just little doubt that the change will have influence on livelihoods and development trajectories (Eriksen & O'Brien, 2011). Developing countries are more prone to the dangers of climate change as they rely basically on climate-sensitive sectors and have little adaptive capacities (McCarthy, et al., 2001; Preston, et al., 2008; Ignatius, 2012; Tesso, et al., 2012). From the fourth assessment report of the IPCC, (2007), the global sea levels have increased since 1993 to about 3mm/year. However, how much the sea levels will rise in the future is hovered around uncertainty and the degree of uncertainty increases as time goes by (Tyler, 2015). its effects are expected to be felt harder within communities characterized by low-income mainly because they lack the financial means to the best abatement methods (Handwerger, et al., 2021).

Many a time, vulnerability to climate change give rise to outcomes which reinforce poverty (Eriksen & O'Brien, 2011). That is, climate risks surges poverty levels especially when a majority of the population is involved in livelihood activities that are highly climate sensitive in low income and developing countries coupled with low adaptive capacities. Also, it may be noted that people vulnerable to climate change may not necessarily be poor and even among the poor there are different levels and patterns of vulnerability. Non-poor and poor households can be affected by climate variability. Even though the level of risks may vary, exogenous shocks could turn around the fortunes of both, indicating that the observed income and poverty levels could change over time as a result of external events. Thus, those whose living standards have improved could all of a sudden reverse in their conditions due to climate shocks making it necessary for poverty to be seen from a dynamic approach as it remains likely that people may fall in and out of poverty (Herrera, et al., 2018). The focus of the developing countries on welfare has generally been on current welfare with a major reason being the inadequacy of

research in the area of poverty in the future or vulnerability to poverty thus, neglecting forward looking welfare analysis (Novignon, et al., 2012). The commonly held view of poverty (World Bank, 2010) which is based on the criteria of current and income (Ruben, 2011) has over the past decades driven developmental policies internationally. Nonetheless new paradigms of the measurement of poverty have emerged recognizing other economic, social and even environmental shocks. These events may affect the potential of people's income and worsen structural inherited and chronic poverty factors such that individuals find themselves even below their original poverty level (Herrera, et al., 2018). The probability that one becomes poor as result of shocks which are idiosyncratic in nature is higher among those within low-income group unlike covariate shocks which happen to all irrespective of their income group and capital endowments (Gunther & Harttgen, 2006). Hence, the assessments of vulnerability seek to estimate the ex-ante, both the expected mean along with the volatility of consumption. Further, vulnerability as is true with poverty should be multidimensional and to be able to be a dynamic concept that acknowledges and captures economic situation change in people because not being poor today may not necessarily mean situation will persist in the future (Moser, 1998; Philip & Rayhan, 2004; Gunther & Harttgen, 2006). Vulnerability to poverty is seen extensively as a step ahead future oriented or forward-looking measure of welfare (Chaudhuri, 2003; Ligon & Schechter, 2003; Tandon & Hasan, 2005; Azam & Imai, 2009). Then the question we ask is; who is vulnerable and why?

Climate change will continue to pose threat to the lives of humans and progresses towards the reduction of poverty (Chaudhury, 2017). However, if people are resilient, the shocks of climate change may not hit so hard. Resilience to impacts of climate change is necessary so as to maintain a sustainable livelihood.

Objectives of the Essay

The principal objective of the essay is to measure the vulnerability to poverty of coastal dwellers as result of sea level rise.

To help achieve this principal objective, the following specific objectives would be explored:

Evaluate the determinants of vulnerability to poverty.

Estimate the percentage of costal dwellers vulnerable to poverty.

Plan Activities

This essay seeks to measure the vulnerability to poverty of coastal dwellers as result of sea level rise. Specifically, the study evaluates the determinants of vulnerability to poverty and also estimates the percentage of costal dwellers vulnerable to poverty. The organization of this essay is in 5 sections. The first section covers the introduction to the essay, the objectives of the essay, the plan activities of the essay as well as some stylized facts. The second section explores related literature to the essay. The Literature review is basically in two parts. The first part (Theoretical Literature) talks about existing theories concerning the subject matter. The second part of the literature review also is the Empirical literature. Here, related studies of the subject matter are explored. The literature review section helps guide in using the best theory and methods for the study as well us identifying the gaps in previous studies in order to explore those gaps. The third section is the methodology section. This section also highlights on the case study area of the study, the variables considered for the study as well as the theoretical and empirical methods used for the research. Moving forward, section four analysis the findings from the empirical methods. This section presents the results and discusses them as well Finally, section 5 presents the conclusion of the essay based on the results and discussions as well as making recommendations.

3.1.1. Stylized Facts

Poverty is the world's greatest challenge (World Bank, 2001; Hasell, et al., 2022). According to Schultz (1980), most people in the world are poor and if the economics of being poor is known, much of the economics that really matter would be known. Alleviating poverty has become the most development priorities of both developing and developed countries (Mansi, et al., 2020). Nevertheless, poverty rates have varied across countries significantly conditional on success of economic growth which consequently ensures sustainable development (Raimi, et al., 2015; Garza-Rodriguez, 2018; Mehedintu, et al., 2019; Peng & Lu, 2020). There remains diverse reason for the existence of poverty however, one of the reasons is environmental and natural shocks (Chaudhury, 2017). One of the greatest challenges the world is facing today is climate change (Copenhagen Accord, 2009) and even if the emissions of greenhouse gases are put to a halt now, its consequences on climate change will still linger in the future. According to the World Resource Institute (WRI), the earth is facing already unusual floods, droughts fires and other extreme weather which are set to augment as the global warming continues. Notably, one

of the most pressing consequences of climate change is sea level rise particularly in low-elevation areas (Tigre, 2013). Unfortunately, even emissions of greenhouse gases are halted climate change will continue for the foreseeable future because the greenhouse gases already accumulated in the atmosphere would continue to make negative impacts (Ligetti, et al., 2007; Committee on Climate Change (CCC), 2010). Climate shocks may make households poor as a result of assets loss, production losses among others (Hallegatte, 2016; Hallegatte, et al., 2016). Climate change is expected to increase the number of poor in both developed and developing countries, threatening sustainable development (Chaudhury, 2017). However, the frequency and intensity of climate induced disasters disproportionately affects the poor as compared to the wealthy in terms of reducing their ability to cope (Chaudhury, 2017). The poor lack finance, alternative livelihoods, are limited in social safety as well as have limited access to technology to aid in adapting to climate change. This implies that the effects of climate change will worsen the situation of the poor and marginalized in the various communities. Unless climate change effects are well integrated into development agendas, it will continue to jeopardize the well-being of humans as well as hinder efforts to reduce poverty.

The analysis of disasters hangs on a fundamental question concerning uncertainty and shocks thus, how communities respond to risk. In the convention of disaster management and climate however, this question is expressed through the concepts of vulnerability and resilience. The 13th goal of the Sustainable development goals focuses on “urgent action to combat climate change and its impacts” with Target 13.1 declaring that there should be strengthening of resilience and adaptive capacity to climate related hazards and natural disasters in all countries. In order to be able to cope with the effects as well as challenges, there is the need to develop adaptation policies or adjustments that could consequently enhance resilience and reduce vulnerability to expected impacts of climate change (Yuksel, 2014). Resilience is seen as the opposite of vulnerability (Adger, 2001; Davoudi, et al., 2012); the ability of the social or ecological systems to absorb while conserving their basic structure and ways of functioning, their self-organization capacity, the capacity to adapt to stress and change (Ibarrarán, et al., 2010). The IPCC also defines resilience as a system’s as well as its component parts’ ability to a hazardous event, absorb its effects, accommodate them or recover from them in time and efficiently including through ensuring the preservation or restoration. Resilience assessments give a set of

participatory tools that enhance the identifying of thresholds, drivers, dynamics that either add to or disintegrate resilience in the social-ecological systems (Alliance Resilience, 2010).

3.2. Literature review

Notwithstanding international efforts, poverty remains extensive scores of countries within the last decade hence its reduction being the major 21st century's development challenge (Abeygunawardena, et al., 2004). Poverty may be increasingly seen as dynamic and multidimensional situation shaped by circumstances and the interaction of individual and community characteristics together with larger social, economic political and environmental processes (Naudé, et al., 2009; Kwak & Smith, 2011; Train & Cannings, 2013; Victor, et al., 2013). Climate change may not be seen as the sole cause of poverty however, studies have identified both direct and indirect ways through which variability and changes in climate could exacerbate poverty especially in low and middle developed countries (Eriksen & O'Brien, 2007; Schipper, 2007; Bohle, et al., 1994) while the World Bank, (2001) highlights the interface between empowerment, security, opportunity and poverty. Alwang, et al., (2001) commends that such line of thinking about poverty considers the concepts of risk and management to the heart of policy dialogue. Many studies poverty is familiarly linked poverty with vulnerability. The concept of vulnerability is evasive yet it is a condition that may be easy to acknowledge it in one's self or another (Kamanou & Morduch, 2004). Nonetheless has been a surge in interest in the analysis of vulnerability amid development economists (Fujii, 2016). The term vulnerability has expanded and may refer to the relationship between poverty, risk and efforts to manage risk (Alwang, et al., 2001). Moreover, vulnerability can be divided in a number of components of risk chains including the risk, or the risky events, the options of managing risk, or the responses to the risks as well as the outcome in terms of loss in welfare. This part reviews theories and concepts surrounding poverty and vulnerability to poverty.

3.2.1. Theoretical literature

A large body of studies recognize that poverty is not fixed thus, entails a time reference (Bane, 1986; Ravallion, 1996). Poverty is an ex-post measure of the wellbeing of a household reflecting only the current deprivation of the household that is, their current lack of resources or their current inability to provide for their current needs. However, the aspect of vulnerability as an ex-

ante measure of poverty broadens the concept of poverty reflecting both the current state of the households as well as their future prospects. Now the distinguishing factor between the ex-post and ex-ante measurement is risk; the uncertainty of the wellbeing of the future. However, without risk, there wouldn't be a difference in ex-ante and ex-post measurements and these risks may come from diverse sources (Chaudhuri, 2003).

Studies including Holzmann & Jorgensen (2000), Holzmann (2001), and Canagarajah et al., (2002) point out the fact that the inclusion of risk aids in designing and implementing social policies. Empirically and theoretically speaking, the nature and magnitude of risks faced by households as well as their access to risk-management mechanisms given the environments in which they operate, assumingly play a vital role in the dynamics and scale of poverty. The vulnerability of a household to poverty at a period or moment is dependent on how the wellbeing of the household evolves over time and in turn relies on the prospect of income in the future, degree of volatility in income and the ability to facilitate consumption when faced with income and livelihood shocks. These accordingly depend on the complex dynamic interconnections between macroeconomic, institutional, socio-political, and physical environment in which the household functions as well as the resources it commands; human, physical and financial together with its behavioral response. From Chaudhuri, (2003), these interconnections and dynamism on the wellbeing of households thus suggest that the expected poverty and vulnerability to poverty is due to; exposure to adverse shocks, long term income generating capacity, low level of human capital, know-how and access to information, physical and psychological disabilities, few productive and financial assets, social exclusion or inadequate networks of social support, limited access to credit and risk-management instruments , living in an unfriendly climatic and limited resources settings, living in areas of insufficient entrepreneurial activity and job creation and working in a sector sensitive to macroeconomic volatility and sectorial shocks.

Various economic literature on poverty have proposed different measurements for vulnerability such as the welfarist approach, expected poverty approach, and axiomatic approach. However, there rarely exist a no consensus on identifying vulnerable individuals in a given population. There have been misunderstandings from the overlap of other related concepts such as expected poverty, expectation of being poor, multi-period poverty and risk expectation (Gallardo, 2018).

More often than never, if a household's current expenditure falls below a certain threshold (poverty line), that household is considered as being poor. The World Bank Poverty Line specifically defines extreme poverty as living on less than \$1.90 per day measured in 2011 purchasing power parity prices. Although studies about poverty are faced with difficulties in identifying an appropriate measure for welfare, household consumption expenditure or income is an acceptable measure of standard (Vecchi, 2007). Vulnerability to poverty alongside is defined to include the probability that a household or individual regardless of being poor or not currently may be poor in the future (Novignon, et al., 2012). While various definitions of poverty may suggest that the poor and non-poor currently may be vulnerable in the future, the scope of the vulnerability depends on the risks the households face and their ability to respond to these risks (Alwang, et al., 2001). In Ghana, coastal flooding has been identified as a major risk faced by people who live in the coastal areas.

Various literature on measure of vulnerability consent that vulnerability have two perspectives namely; the time horizon and the welfare measure (Novignon, et al., 2012). Usually in measuring vulnerability to poverty, three major concepts are distinguished namely, vulnerability as expected poverty (VEP), vulnerability as expected low utility (VEU) and vulnerability as uninsured exposure to risk (VER) (Hoddinot & Quisumbing, 2003; Christiaensen, 2004). The VEP method defines vulnerability on the basis of household expected consumption expenditure above a certain threshold. The VEU method also measures vulnerability as the utility derived from some certainty-equivalent consumption level and expected utility of consumption while the VER method expresses the concept in terms of loss in household welfare culminating from lack of risk management tools (Hoddinot & Quisumbing, 2003).

As mentioned earlier, there remains no consensus about the measurement of vulnerability however, some methods include; the welfarist approach, the expected poverty approach, and the axiomatic approach as mentioned earlier. With respect to the welfarist approach, Ligon & Schechter, (2003) as well as Elbers & Gunning, (2003) developed a measure of vulnerability based on foundations of welfare. According to Ligon & Schechter, (2003), an individual i 's vulnerability v_i is defined as;

$$v_i = u_i(z) - E[u_i(c_i(\omega))]$$

Where u_i is the instantaneous utility function, $E[.]$ is the expected operator, $z(\geq 0)$ is the threshold z -level certainty-equivalent consumption below which the individual is considered vulnerable. $c_i(\omega)(\geq 0)$ is the consumption expenditure per capita for the individual i that is dependent on the state of the world $\omega(\in \Omega)$ for state space Ω . Notably, z represents the poverty line in poverty analysis in the static framework. Thus, it is also interpreted as the poverty line below when it is appropriate to do so. Again as c_i is interpreted as the consumption expenditure per capita, the presentation remains unchanged even if it is interpreted as it is interpreted as income or other cardinal and observable measure of individual welfare.

For the Expected poverty approach, vulnerability is observed as the expected poverty. That is, given the current condition, vulnerability relates to how likely it is for an individual to fall into poverty given the time frame. This makes the time frame very important in this approach. Unlike Elbers & Gunning, (2003) where time frame is considered infinite, this approach specifies time. However, for simplicity's sake, the expected poverty approach could be discussed in a static framework by fixing the time horizon despite the fact that time is relevant. It remains important to state that vulnerability is referred to as ex- ante consumption while poverty is referred to as ex-post consumption.

And finally, regarding the Axiomatic Approach, unlike basing the definition of vulnerability on utility or poverty at the individual level, this approach derives the measure of vulnerability from a set of axioms that outlines the properties that an ideal vulnerability would satisfy (Fujii, 2016).

3.2.2. Empirical Literature

A number of economists classify poverty as either chronic or transitory which may depend on the time reference. That is, on one hand, a household which is entirely poor for the period being considered or the reference period, is classified as chronically poor while on the other hand the household moves in and out of poverty during the reference period, it is referred to as transient poor. The reference period depends on both the survey constraints as well as the concept (Alwang, et al., 2001). Poverty could also be distinguished by risk related and non-risk related (Morduch, 1997). The risk related is referred to as stochastic poverty and it occurs when current consumption falls below the poverty line which also below permanent income (Alwang, et al., 2001). Stochastic poverty occurs because of the impossibility to borrow against income in the future for reasons including; imperfect credit markets (Morduch, 1997). However, when

permanent income occurs below the poverty line, structural poverty occurs which may be due to shocks associated with the structure of household. As permanent income is below the poverty line, the possibility remains that a household could escape current poverty for a sustained period. Thus, regarding structural and stochastic poverty, vulnerability implies that being vulnerable to risky events in that, a bad outcome could make a household move below the poverty line and they have to decrease current consumption for survival purposes (Alwang, et al., 2001). Suryahadi, et al., (2000) defined vulnerability to poverty as the risk that a household will fall into poverty at least once in the next few years thus, measured as the probability with households having a greater or lesser degrees of vulnerability. Again, like Suryahadi, et al., (2000), Mansuri & Healy, (2000) defined vulnerability as a forward-looking probabilistic measure and even argued that, vulnerability can be measured even without panel data. Thus, cross section data and other time series data could be used to generate a probabilistic forward-looking measure. Also, alternative economic definitions have been suggested by studies which define vulnerability as the probability of falling below poverty threshold over a given period of time (Alwang, et al., 2001). Definition as such embraces concepts as risk and response without losing the analytical precision of conventional analyses of poverty. An enhancement of this definition may weight the probability by time or expected time spent below the line and depth. Furthermore, Ravallion, (1998) suggest the decomposition of chronic and transient poverty accounting for time spent below the poverty line. However, this suggestion does not explicitly account for the stochastic nature of poverty (Alwang, et al., 2001). The UN recognizes the threat that climate change inflicts hence including Target 1.5 under the first sustainable development goal “end poverty in all its forms where Target 1.5 affirms that by 2030, the world must “build resilience of the poor of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate related extreme events and other economic, social, and environmental shocks and disasters” (United Nations, 2016). This section of the literature review reviews previous studies on poverty and vulnerability to poverty.

3.3.2a. Studies on poverty and vulnerability to poverty with cross-sectional data set

Arguing on the point that a forward-looking anti-poverty intervention is imperative for the preventing rather than alleviating poverty, Chaudhuri, et al., (2002) sets out to assess household vulnerability to poverty in cross section data. The study concludes that the fraction of the population which faces a non-negligible risk of poverty considerably is greater than the fraction

which is observed to be poor. Also, there's remarkable differences in the sources of vulnerability to poverty among different segments of the population

Utilizing the vulnerability estimation method developed by Chaudhuri, (2000) Suryahadi and Sumarto, (2003) examined poverty and vulnerability in Indonesia before and after the economic crisis. The study found that the rate of poverty increased substantially and that much of the increase was due to a large increase in the category of chronic poor. Also, the proportion of households highly vulnerable to poverty had doubled since the economic crisis leading to a jump in total vulnerable group from one-fifth of the population before the crisis to more than one-third after the crisis.

Jamal, (2009) assessed the vulnerability to poverty in Pakistan. This study employs a cross-sectional data while employing the methodology developed by Chaudhuri, et al., (2002) for estimating vulnerability to poverty using cross-sectional data. The results showed that about 52 percent of the population was vulnerable to poverty during 2004-2005.

Azam & Imai, (2009) studied vulnerability and poverty in Bangladesh estimating ex-ante poverty and vulnerability from Household Income Expenditure Survey (HIES) data in 2005 following Chaudhuri (2003). Poverty is not the same as vulnerability, the study concluded. Also, people without education or simply agricultural households are more vulnerable to poverty.

With climate volatility having the tendency to impact agricultural productivity, Ahmed, et al., (2011) used climate model projections, statistical crop models and general equilibrium economic simulations to ascertain how vulnerable the population of Tanzania are to impoverishment by climate variability could be between the late 20th century and the early 21st century. Scenarios of future climate from multiple climate models show no consensus on future changes in temperature and rainfall therefor the study suggest that, evaluating potential changes in volatility and not just the mean climate state may be necessary for the analyses of poverty implications of climate change.

Using cross sectional data from Ghana Living Standards Survey round 5 (GLSS5), (Novignon, et al., (2012) examined the relationship between health status and vulnerability to poverty. The study employed a three-staged Feasible Generalized Least Squares (FGLS) procedure to estimate vulnerability to poverty and to model the health status effect on expected future consumption and

variations in consumption in the future. It was concluded that about 56% of Ghana's households are vulnerability to poverty in the future which was higher than the observed poverty at that time.

Azeem, (2016a) investigated the prevalence, sources and distribution of household vulnerability to food-insecurity in Punjab, Pakistan. The study applied a multilevel model on about 90000 households and found that the share of households vulnerable to food insecurity is higher than the share that was food-insecure at that time. Interestingly, rural area households are the least vulnerable. The risk-induced vulnerability was also higher than the structural-induced vulnerability. Also, vulnerability to idiosyncratic shock was higher than vulnerability to covariate shocks. In all, the study concluded that households are vulnerable not as a result of poor resource endowments however, due to risk.

Azeem, (2016b) estimates the prevalence and extent of vulnerability to poverty in the Punjab province of Pakistan. The survey data of about 90000 households is analyzed by a multilevel model. The estimates showed that vulnerability is higher than the rate of poverty while poverty induced vulnerability is higher than risk induced vulnerability. Furthermore, idiosyncratic-vulnerability is higher than covariate-vulnerability.

Hallegatte, (2016) examines the potential impact of climate change and climate policies on poverty reduction. The study provides guidance on how a win-win situation so that climate change policies contribute to poverty reduction and also that poverty-reduction policies contribute to climate change mitigation and resilience building. The report found that climate change is a great barrier to a sustained eradication of poverty future impacts on poverty are determined by choices of policies.

Dwelling on misunderstandings linked with measurement of vulnerability, Gallardo (2018) worked on identifying vulnerability to poverty. The paper details a conceptual discussion on vulnerability to poverty and related elements by reviewing a substantial number of identifying criteria in the literature. The study thus, identified two main elements in identifying individuals who are vulnerable and these major keys are; an expected wellbeing below the poverty line and a relevant risk of falling into poverty as a result of downside deviation from a reference level of wellbeing.

Herrera, et al., (2018) studied the effect of climate variability on vulnerability to poverty in Nicaragua. The study employed a multilevel empirical framework, where per capita consumption is linked to household, regional and climate characteristics. The results point out in affirmation to a negative impact of climate variability on consumption per capita. It was recommended that stronger public policies be put in place for adaptation.

Handwerger, et al., (2021) sought to identify the geographic areas in which low-income and communities of color along the coastlines of North and South Carolina in the USA will experience the most serious effects of sea level rise. Geospatial mapping was employed to estimate the total area affected. The project finds that over 2.2 million people and at least 370000 Blacks or economically disadvantaged people will be impacted by 2100 by sea level rise.

3.3.2b. Studies on poverty and vulnerability to poverty with panel data set

Christiaensen & Boisvert, (2000) illustrated a methodology to empirically measure household food vulnerability. Here, food vulnerability was defined in terms of the probability now of being undernourished in the future. The analysis was based on panel data from northern Mali, collected in 1997 to 1998. The results showed that there is an overlap between the groups of currently undernourished and food vulnerable households however, they are not identical. Again, household headed by females are less vulnerable to drought shocks.

Dwelling on the argument that poverty is familiarly linked with vulnerability and the fact that there's no consensus about the definition and measurement of vulnerability, Kamanou & Morduch, (2004) reviewed theory and described strengths and limits of proposed measures. The study proposed a definition of vulnerability and developed a general empirical framework that combines Monte Carlo and bootstrap statistical techniques. This approach estimated the expected distribution of future expenditures for every household and then calculated the vulnerability measures as a function of the distributions. The study by their approach addressed the weakness in existing methods and can be implemented with panel data. The approach was applied to a panel data (1985-1986) which proved the definition considerable.

On the issue of the neglect of important dimensions of household welfare in traditional poverty measures, Ligon & Schechter, (2003) set out to construct a measure of vulnerability that allows for quantifying the loss in welfare as a result of poverty in as much as loss associated with any of a variety of different uncertainty sources. The study applied this measure to a panel dataset from

Bulgaria in 1994 and arrived at a conclusion that poverty and risk play practically equal roles in welfare reduction. Also, aggregate shocks are more important than idiosyncratic risk sources while households being headed by educated and employed males are less likely to be vulnerable aggregate shocks than are otherwise households.

Based on the definition of vulnerability to poverty as the probability of a household or individual falling into poverty in the future, Zhang & Wan, (2008) used a household panel data set from rural China to attempt to assess the extent to which vulnerability to poverty can be measured. The assessment was based on the comparison between predicted vulnerability and actually observed poverty. The study found that, the precision of the prediction firstly varies with the poverty line thus suggested setting the line at 50% percent so as to improve predictive power. Secondly, precision depends on how permanent is estimated and lastly, precision depends on chosen poverty line.

Jha, et al., (2010) examined the profile of poverty and vulnerability in Tajikistan making use panel data at the household level for 2004 and 2005. The study found that increase in remittances from workers working overseas caused the drop in poverty. Again, households are more likely to be poor if they live in rural areas, if there are more children, if there is a pensioner in the household or if the pensioner is the household head. Also, about half of the current non-poor are vulnerable to poverty. Moreover, the analysis submits that inequality-induced vulnerability is large while risk-induced vulnerability is moderate.

Imai, et al., (2011) constructed ex-ante measures of vulnerability utilizing data from Vietnam Household Living Standard Survey (VHLSS) which cover the whole Vietnam in 2002 and 2004. These measures are then compared with static indicators of poverty (headcount ratio in a given year). The analyses show that general vulnerability in 2002 generated to poverty in 2004. Also, vulnerability of the poor extends their poverty and lastly sections of non-poor but vulnerable tumble in to poverty. Again, long lasting reduction in poverty dwells on accurately identifying the vulnerable, the sources of vulnerability and the designing of social safety nets capable of enabling the vulnerable to reduce risk and cope better.

Kwak & Smith (2011) examined the impact and potential interactions of health, education and consumption dimension of persistent poverty at the household level. The study employed a panel data set from the Ethiopian Rural Household Survey. The study then developed a framework to

operationalize the multidimensional trap concept involving two or more simultaneous different poverty dimension of persistent poverty. An implication of the multiple trap framework was tested by comparing structural income dynamics across groups. The study found that, among the poorest, those with both chronic undernutrition and illiteracy have the lowest implied equilibrium, those with one of the chronic conditions have intermediate equilibria and those without either condition have the highest asset equilibrium.

Landau, et al., (2012) investigated the accuracy of ex ante assessment of vulnerability to income poverty using cross sectional data and panel data. Again, the study utilized a long-term panel data from Germany and applied distinct regression models based on household covariates and previous-year equivalence income to distribute a household into vulnerable or not. Making use of the Receiver Operating Characteristics (ROC), predictive performance was assessed. The ROC takes into account false positive as well as true positive rates. The study concludes that, estimates based on panel data are more accurate than estimates on cross-sectional data. However, for Germany, the vulnerability prediction accuracy is limited even when panel data was used.

Bah, (2013) proposes a method to estimate an index of ex ante vulnerability to poverty, defined as the probability of being poor in the near future given current observable characteristics using panel data. The method relies on the estimation of the expected mean and variance of future consumption which is conditional on current consumption observable characteristics. A vulnerability index or predicted of future poverty is generated which is viable in predicting future poverty, including out of sample. The study found that about 80% of households with a 2000 vulnerability index of 100% are poor in 2007. The study recommends this approach as useful to complement traditional poverty measures.

Hallegatte & Rozenberg (2017) argued that analysis of the economic impact of climate change neglect the distribution of climate change with countries or the impacts on poverty. Therefore, filling this gap, and providing an assessment of impacts of climate change at the household level to investigating the consequences of climate change for poverty and for poor people remains the goal of this study. The study combines assessment of the physical impacts of climate change in various sectors with household surveys. Specifically, the study calls attention to how rapid and inclusive development is capable of reducing the future impacts of climate change on poverty.

Numerous studies that have been cited above have contributed their quota in the area of poverty and vulnerability to poverty. What differentiates these from the work is the risk involved as well as the area of study. It is easier to say that most studies on vulnerability center on the measure of it as there's no consensus measure for the concept. Thus, the studies on estimating people who are vulnerable to poverty remains important to be studied especially in Ghana. Again, in studies that have attempted estimating the number of people who are vulnerable to poverty, the risk factor is usually no the effect of climate change. Moreover, in studies where the risk factor is climate change, these studies talk of overall climate change effects in aggregate terms for instance aggregate temperature and rainfall changes which may overestimate the vulnerability to poverty. Nonetheless, this study focuses on just a factor of climate change which is sea level rise specifically coastal flooding. Furthermore, there hardly exist any research in Ghana estimating the vulnerability to poverty with environmental threat as climate change as the risk fact. Lastly as this study in a way of filling the above gaps could be a literature guide for further studies.

3.3. Methodology

Vulnerability remains a vital phase of households' poverty experience. While currently not in poverty, many households perceive their proneness to events of poverty. Poverty studies have embraced broad-gauge concepts (Waglé, 2008) however, a lot of studies measure poverty as fall in current income consumption expenditures from the poverty line which make poverty to be measured at just a point in time. Suryahadi, et al., (2000) suggest an expansion of the measures of poverty to vulnerability; defining vulnerability as the probability, the risk of a household experiencing leastways, an episode of poverty in the near future. Vulnerability to poverty or poverty risk is an aspect of poverty that needs to be understood as the increase in shocks result in many households in developing countries being poverty stricken (Azeem, et al., 2016a; Azeem, et al., 2016b; Feeny & McDonald, 2016). In the microeconomic perspective, the logic is the probability of one's wellbeing deteriorating as a result of a shock which reflects the external pressures that people are subjected to though they may not be completely be deprived of their capability of reacting. The concept of vulnerability is a complex one and dynamic as well anticipating the possible changes in the future. Again, since the future is not certain, the assumption is that vulnerability rises over time thus, the risk over several years is probably higher than just over a year (Suryahadi, et al., 2000).

3.3.1. *Econometric Technique*

The observed poverty level of a household is an ex-post measure of the household's wellbeing. However, poverty as a phenomenon is stochastic thus, the current level of a household may not be the best guide to the expected poverty level of that household in the future. Therefore, if there is supposed to be an appropriate intervention for alleviation of poverty now and in the future, there's the need for critical assessments of households' vulnerability to poverty thus, a broadening of the scope of poverty. In other words, for policy purposes, the ex-ante risks of a household falling in to poverty if not currently poor or will remain poor is viable. Among the households who are poor now, there may be those who are poor transitorily and those others who would continue being poor or even poorer in the future.

Several studies exist on the concept of vulnerability where panel data have been used due to the idea of the forward-looking nature of the concept (Christiaensen & Boisvert, 2000; Ligon & Schechter, 2003). Yet, there also literature in support of the use of cross-sectional data in estimating vulnerability to poverty. (Chaudhuri, 2000; 2003; Chaudhuri, et al., 2002; Suryahadi & Sumarto, 2003; Appiah-Kubi, et al., 2008; Azam & Imai, 2009; Novignon, et al., 2012).

Following the probability that a household h finds to be consumption poor or poor as far as consumption is concerned at time $t + j$ is expressed as

$$V_{h,t} = pr(\ln C_{h,t+j} < \ln z) \quad (1)$$

Where $V_{h,t}$ expresses the vulnerability of the household at time t , with $C_{h,t+l}$ as the consumption of the household h at time $t + l$ and z also representing the poverty line of household consumption whereas \ln is the natural log.

It is noted that consumption in itself could be expressed as;

$$\ln C_{h,t} = X_{h,t} \beta + \epsilon_{h,t} \quad (2)$$

Here, $C_{h,t}$ is the per capita consumption expenditure for the household h , $X_{h,t}$ is also the household characteristics that are observable and β depicts the vector of the parameters whereas $\epsilon_{h,t}$ represents the zero-mean disturbance term. The zero-mean disturbance term captures the idiosyncratic factors of the household which contribute to differential level of per capita consumption for households that have the same characteristics

It is imperative for some assumptions to be made by using a cross sectional data. Foremost, the disturbance term ϵ_{it} is log-normally distributed implying that consumption expenditure, C_{it} has a log-normal distribution. Further, the economy's structure is considered stable overtime where the possibility of aggregate shocks is ruled out. The assumption of a log-normally distributed disturbance term and consumption expenditure enables the estimation of the probability of a household with characteristics X_{it} is going to be poor (vulnerability level of household). While the assumption of the stability of the economy's structure over time indicates that the uncertainties about consumption in the future stem only from the uncertainty about idiosyncratic shocks the household will face. This assumption implies that the economy's current structure will be prevalent at least, in the future. For a panel data, these assumptions may not be imperative as they may identify the stochastic process of the structure of the economy.

With these assumptions in mind, the vulnerability to poverty of a give household h with characteristics X_{it} would then be calculated using the estimated coefficients of equation (2).

Thus,

$$\widehat{V}_{it} = pr(\ln C_{it,t+1} < \ln z | X_{it}) = \Phi(\ln z - X_{it}\widehat{\beta}\widehat{\sigma}) \quad (3)$$

Here also, \widehat{V}_{it} is the estimated vulnerability to poverty that is, the probability that the per capita level of consumption is going to be lower than the poverty line subject to some household characteristics. $\Phi(\cdot)$ is the cumulative density of the standard normal distribution error from equation (2).

There are existing studies that explore household consumption behavior and treat the disturbance term as arising from measurement error and therefore assume the variance of the disturbance is the same for all households. However, Chaudhuri, (2003) argues that this assumption leads to inefficient estimates in the main parameters of interest as well as vulnerability estimates. This issue is thus resolved by a simple functional form relating variance of the consumption to household consumption characteristics. That is;

$$\sigma^2 = X_{it}\theta + \eta_{it} \quad (4)$$

For estimating β and θ , a three-stage Feasible Generalized least square procedure is employed as recommended by Amemiya (1977). Firstly, equation (2) is estimated by the Ordinary Least

Squares (OLS) procedure then the estimated residuals from this same equation (2) are used to estimate the equation below by OLS.

$$\sigma_{ols,h}^2 = X\hat{\theta} + \hat{\eta} \quad (5)$$

The predicted values from this auxiliary are used to transform equation (5).

$$\frac{\sigma_{ols,h}^2}{X\hat{\theta}} = \frac{X}{X\hat{\theta}}\theta + \frac{\eta}{X\hat{\theta}} \quad (6)$$

By an OLS estimation equation (6) gives an asymptotically efficient FGLS estimate, $\hat{\theta}_{FGLS}$. it is seen that $X\hat{\theta}_{FGLS}$ is a potent estimate of $\sigma_{e,h}^2$ which is the variance of the idiosyncratic component of household consumption. Again, equation (2) is transformed with the standard error of $\hat{\theta}_{FGLS}$ given by;

$$\sigma_{e,h}^2 = \sqrt{X}\hat{\theta}_{FGLS} \quad (7)$$

$$\frac{\ln C}{\hat{\sigma}_{\epsilon,h}} = \left(\frac{X_h}{\hat{\sigma}_{\epsilon,h}}\right)\beta + \frac{\epsilon_h}{\hat{\sigma}_{\epsilon,h}} \quad (8)$$

The OLS estimation of equation (8) outturns an asymptotically estimate of β . The estimated β_{FGLS} and σ_{FGLS} allows for a direct estimation of expected log consumption in equation (9) below and expected variance of log consumption in equation (10) also below.

$$E[(\ln \hat{C}|X)] = X\hat{\beta} \quad (9)$$

$$Var[(\ln \hat{C}|X)] = \hat{\sigma}_h^2 = X_h\hat{\sigma} \quad (8)$$

Lastly, by the assumption that consumption is log normally distributed, we can estimate vulnerability to poverty as;

$$\hat{V}_h = \Phi\left(\frac{\ln z - X_h\hat{\beta}_{FGLS}}{\sqrt{X_h\hat{\sigma}_{FGLS}}}\right) \quad (9)$$

In sum, it should be noted that vulnerability to poverty is conditional on distributional normality of log consumption, the choice of poverty line, the expected log consumption and expected variability of log consumption. The level of vulnerability to poverty reduces as expected consumption and expected variability in consumption increases

3.3.2. Vulnerability to poverty threshold

Following Novignon, et al., (2012), the study employs 0.5 as the vulnerability threshold as it is an extensively accepted threshold and reasonable (Suryahadi, et al., 2000; Chaudhuri, et al., 2002; Zhang & Wan, 2008). The justification of the choice of 0.5 include the fact that it makes intuitive sense to say that a household with a 50% probability of falling in to poverty in the next period is vulnerable to poverty. Again, a household with a current consumption level equal to the poverty line or faces a zero mean shock has a one period ahead vulnerability of 0.5. In the limit, being currently poor and being vulnerable coincides as the time horizon approaches zero (Suryahadi, et al., 2000). Furthermore, a 0.5 vulnerability line provides a more improved prediction (Zhang & Wan, 2008). The implication is that if a household has an estimated vulnerability to poverty above or equal to 0.5, then, it is considered as being vulnerable to poverty.

3.3.3. Poverty line

Two poverty lines are employed in this vulnerability to poverty study computations namely; the upper poverty line of GhC 1,314 per adult per year and a lower poverty line of GhC 792.05 per adult per year to allow for sensitivity. These poverty lines are taken from the Ghana Living Standards Survey round 7 (GLSS7) (2017) capturing the poverty trends in Ghana from 2005 to 2017. Respondents with consumption expenditure falling below the lower poverty line are extremely poor and unable to meet their basic nutritional needs. Respondents whose consumption expenditure falls above the upper poverty line on the other hand are not poor and are capable of meeting their nutritional requirements as well being able to afford their basic non-food items.

3.3.4. Time Horizon

The time horizon is any period in the future Novignon, et al., (2012) argues that the certainty of the probability of a respondent becoming poor in just a period ahead may be impractical. The time period thus, is specified as $t + j$ and not $t + 1$, where $j \geq 1$ (Chaudhuri, et al., 2002; Christiaensen & Subbarao, 2005).

3.3.5. Data

This study makes use of survey data collected by author from four coastal towns in the Keta South Municipality (KSM) and Keta Municipality (KM) the Volta Region of Ghana namely Adina, Amutinu, Selarkope and Kedzikope (KM). A sample of over 500 households were interviewed in total with the main focus on household heads. The sample size is chosen based the

formular; $\frac{N}{1+e^2} = \frac{N}{1+0.05^2}$ (Bartlett, et al., 2001) where N is the population and e is the margin of error. This formular is repeated for all communities involved in the study. The population data on households and household heads was taken from the Ghana statistical service (GSS) specifically from the office of the GSS in volta region of Ghana, Ho. The population data was based on 2010 population census of Ghana however, adjusted to be a quasi-proxy for 2021 population using the annual population growth rate of the volta Region. This is because the 2021 population and housing data was not yet available at the time of the survey. The survey design of the various households was random and any household of the community could be utilized. After the survey, about 517 respondents had responded to the survey although the study looked forward to about 565 respondents. Furthermore, the data was cleaned based on the responses which came to about 423 respondents. In all 423 respondents were used for the analysis.

3.3.6. Variables

The table 20 presents the variables used in the regression analysis as well as their description.

Table 20. Variable Description

Variables	Description
SLRKnow	Knowledge of sea level rise, Yes or No (Dummy =0 for No and 1 for Yes)
GenderD	The Gender of the respondent, Male or female (Dummy= 0 for Male and 1 for female)
Edu2	The Education status of the respondent; formal education or not (Dummy= 0 for no formal education and 1 for formal education)
NewMaritalStatus	The marital status of the respondent, whether married or not (0 for single and 1 for Married)
Workhours	The number of hours in a day the respondent works
HHnum	The number of people in the household
Fishingactivities	Whether the respondent engages in fishing activities, Yes or No (Dummy= 0 for No and 1 for Yes)
Saltminingactivities	Whether the respondent engages in salt mining activities, Yes or No (Dummy= 0 for No and 1 for Yes)
Otherlivelih	Whether the respondent engages in other livelihood options other than Fishing activities and salt mining activities, Yes or No (dummy= 0 for No and 1 for yes)
SLRCope	Whether the respondent is able to cope with the rise in sea levels, Yes or No (Dummy= 0 for no and 1 for Yes)
SLREffect	Whether the respondent is affected by sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
SLRPropLoss	Whether the respondent has lost properties due to sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
SLRDisplace	Whether the respondent has been displaced due to sea level rise, Yes or No (Dummy= 0 for No and 1 for Yes)
Annual Income	The annual income of respondents
AdinaTown (Townn1)	If the respondent lives in Adina, Yes or No (Dummy= 0 for No and 1 for Yes)
AmutinuTown (Townn3)	If the respondent lives in Amutinu, Yes or No (Dummy= 0 for No and 1 for Yes)
KedzikopeTown (Townn0)	If the respondent lives in Kedzikope, Yes or No (Dummy= 0 for No and 1 for Yes)
SelakorpeTown (Townn2)	If the respondent lives in Selarkope, Yes or No (Dummy 0 for No and 1 for Yes)

3.3.7. Characteristics of respondents.

The survey results for personal, economic and social characteristics of respondents are shown in the Table 21 below. The results of the questionnaire distributed for the study showed an average age of approximately 48 years while about 44% of these respondents are females and about 56% are males. Also, concerning educational status, almost 41% of the respondents have no formal education, about 46% have primary education and about 11% with secondary education while less than a percentage have tertiary education. The average family size of respondents is approximately 7 people. Averagely, respondents work approximately 6 days in a week and 10 hours in a day. Again, with respect to the livelihood options, most of the respondents are involved in fishing activities. For instance, about 69% of the respondents are involved fishing activities only, 6% are involved in fishing activities and other activities, less than 1% involved in fishing activities, salt mining activities and other activities. Furthermore, salt mining comes as another livelihood option respondents are involved in. About 3% are involved in just salt mining activities while about 8% are involved in both salt mining and fishing activities while approximately 1% is involved in salt mining activities and other activities. Lastly, 12% of the respondents are involved in other activities other than either fishing activities and salt mining activities. The fishing activities include mainly; fishing (beach seine, pair seine, toga and poly fishing), fish monging as well as selling and buying of fish among others. On the side of salting, the main activities are; mining of salt, buying and selling of salt and laborer working. With respect to the respondents involved in other activities, most of them are petty traders (selling food stuff, selling cooked food, operating drinking bars), carpentry, driving among others. Averagely, respondents receive an income of GHC 6250 annually. When questions were asked about whether they receive relief items when there's coastal flooding from government, NGOs and family members, about 41% of them respond that they have received mainly items in the form of food, shelter items other items from the government. About 33% have received these same items from NGOs and private people while only about 18% have received help from family members.

Table 21. Descriptive Statistics of respondents' characteristics.

Respondents' Characteristics	Mean	Standard Deviation	Min	Max
Age	48.300	12.759	20	90
GenderD	0.558	0.497	0	1
Edu2	0.587	0.492	0	1
NewMaritalStatus	0.650	0.477	0	1
workdays	5.846	0.688	1	7
workhours	10.458	2.627	1	24
HHnum	7.329	3.817	1	27
Fishingactivities	0.832	0.374	0	1
Saltminingactivities	0.132	0.339	0	1
Otherlivelih	0.200	0.400	0	1
Annual Income	6258.719	2978.836	2550	10000
AdinaTown	0.490	0.501	0	1
AmutinuTown	0.225	0.418	0	1
KedzikopeTown	0.185	0.389	0	1
SelakorpeTown	0.097	0.297	0	1
GPSLongs	1.055	0.034	0.984	1.189

3.4. Result and Discussion

The estimates of the vulnerability to poverty based on the extreme poverty and normal poverty lines are presented in table 22.

Table 22. Determinants of vulnerability to poverty.

VARIABLES	Extreme Poverty	Standard Errors	Normal Poverty	Standard Errors
VP				
GenderD	-2.628	(-1.677)	-1.304	(-0.839)
Age	1.308***	(-0.061)	0.201***	(-0.03)
Edu2	-0.06	(-1.587)	-0.172	(-0.794)
NewMaritalStatus	16.337***	(-1.61)	2.544***	(-0.805)
1.Townn	63.277***	(-2.354)	7.370***	(-1.177)
2.Townn	56.829***	(-3.173)	4.089**	(-1.587)
3.Townn	60.028***	(-2.598)	6.656***	(-1.3)
Saltminingactivities	42.206***	(-8.596)	5.305	(-4.299)
Fishingactivities	-64.817***	(-4.59)	-3.653	(-2.296)
OtherLivelih	2.986	(-5.997)	7.570**	(-3)
SaltWorkHrs	-3.529***	(-0.749)	-0.433	(-0.375)
FishnWorkHrs	3.671***	(-0.338)	0.511***	(-0.169)
OtherActHrs	-2.662***	(-0.515)	-0.807***	(-0.258)
SLRPropLoss	14.934***	(-1.795)	1.828**	(-0.898)
SLRDisplace	20.496***	(-1.691)	1.129	(-0.846)
SLREffect	0.639	(-2.435)	0.039	(-1.218)
		(-		
var(e.VP)	213.512***	14.822)	53.416***	(-3.708)
Constant	-46.137***	(-4.877)	79.551***	(-2.44)
Prob > chi2	0.0000		0.0000	
LR chi2(16)	802.32		133.99	
Pseudo R2	0.1908		0.0452	
Observations	415		415	

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 23. Description of variables in the regression.

Variable	Description
VP	Vulnerability to Poverty
GenderD	Gender
Age	Age
Edu2	Education
NewMaritalStatus	Marital Status (married or unmarried)
1.Townn (Adina) 2.Townn (Selarkope) 3.Townn (Amutinu)	Town 1, 2, 3 compared to Town 0
Saltminingactivities Fishingactivities OtherLivelih	People engaged salt mining activities, Fishing activities and other livelihood activities other than the above 2
SaltWorkHrs FishnWorkHrs OtherActHrs	Hours spent at salt mining activities, fishing activities and other livelihood activities respectively
SLRPropLoss	Property loss due to sea level rise.
SLRDisplace	Displacement by sea level rise
SLREffect	Being affected by sea level

	rise
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The result of the vulnerability to extreme poverty shows that, Age, marital status, where a respondent lives, the livelihood activity a respondent engages in, the hours they spend at work, their displacement and their losing of properties due to sea level rise significantly impact their vulnerability to extreme poverty. The older one gets, the vulnerable they are to poverty. The married respondents are vulnerable to poverty as compared to the unmarried. Being married comes with responsibilities which may come as a burden and thus, makes one vulnerable to being extremely poor compared to an unmarried counterpart. Interestingly living in the various towns make respondents vulnerable to extreme poverty. This may be as a result of people living very close to the sea therefore as the sea level keeps rising and they get affected, they become extremely poor. Concerning livelihood activities too, being engaged in salt mining activities makes one vulnerable to extreme poverty, yet it is surprising that the more hours you engage in salt mining activities, the less you are vulnerable to extreme poverty. Again, being engaged in fishing activities does not make one vulnerable to extreme poverty yet the more hours you spend doing a fishing activity the vulnerable you are to extreme poverty. In addition, being engaged in other activities other than fishing activities makes one vulnerable to poverty. This could be as a reason that some of those who engage in other livelihood activities do their activities around the sea area and some may deal with proceeds from the sea so they sea level rise may affect the services they provide. However, the more hours you dedicate towards these activities the less vulnerable you are to extreme poverty. Lastly, as people lose properties as a result of sea level rise, they become vulnerable to extreme poverty. And as respondents become displace due to flooding, they are vulnerable to poverty as well.

Aside analyzing factors leading to vulnerability to extreme poverty the study analyzed the factors affecting vulnerability to normal poverty. Here, the poverty line which is used is higher in amount than the amount used in the vulnerability to extreme poverty case. These results are not so different from the results of vulnerability to extreme poverty. The results showed that the factors that affect one's vulnerability to poverty include; Age, marital status, region of abode, livelihood activities people engage in, hours spent at work as well as loss of property due to sea level rise. The older one gets, the vulnerable they are to poverty. Married household heads, are

vulnerable to poverty as compared to those who are not married. Also, living in the various towns make respondents vulnerable to extreme poverty. Here also, engaging in other livelihood activities makes one vulnerable to poverty yet surprisingly, spending more hours in these activities does not make one vulnerable to poverty. Engaging in fishing activities does not significantly impact one’s vulnerability to poverty yet, the more hours one dedicates to engaging in fishing activities the vulnerable they are to poverty. Unlike, the vulnerability to extreme poverty case, displacement as a result of sea level rise does not significantly impact one’s vulnerability to poverty.

Moving forward, the study estimated the number of respondents who are vulnerable to extreme poverty as wells as those who are vulnerable to normal poverty. Tables below shows who and who are not vulnerable. Table 24. presents respondents who are vulnerable to extreme poverty.

Table 24. Vulnerability to extreme poverty.

Vulnerability	Range	Freq.	Percent	Cum.
	0	129	31.08	31.08
	1	286	68.92	100
Total		415	100	

The Table 0.5 shows the number and percentage of respondents who are vulnerable to extreme poverty. Zero (0) under the range column represent those who are not vulnerable while one (1) represent those who are vulnerable. The table shows that 289 respondents out of 415 representing 68.92% are vulnerable to extreme poverty. This is quite alarming as more than half of respondents are liable to extreme poverty knowing well that poverty has so many consequences.

Table 25. Vulnerability to extreme poverty (Gender)

Vulnerability	Female	Male	Total
0	51.16	48.84	100
1	40.56	59.44	100
Total	43.86	56.14	100

The Table 25 shows the distribution of vulnerability to extreme poverty based on gender. It can be inferred from the table that interestingly male household respondents are vulnerable to extreme poverty as compared to their female counterparts. 59.44 % of male respondents are vulnerable to extreme poverty while about 41% of females are vulnerable to poverty. The reason

could be that men are affected more by sea level rise while they are burdened more in terms of household dependents as well making the more vulnerable than women.

Table 26. Vulnerability to extreme poverty (Education).

Vulnerability	No formal education	Formal Education	Total
0	26.36	73.64	100
1	47.9	52.1	100
Total	41.2	58.8	100

The Table 26 represents the distribution of vulnerability to extreme poverty based on education. It is surprising to observe that the percentage of those who do not have any form of education is less than those who have had some form of education. From the table, 47.9% of respondents who have no form of education are liable to extreme poverty as against about 52% of educated respondents vulnerable to extreme poverty. Usually educated individuals have particular professions they are well-versed in so when that profession is being threatened it becomes difficult to engage in other professions as compared to unemployed counterparts thus, making them more vulnerable.

Table 27. Vulnerability to extreme poverty (Marital Status).

Vulnerability	Unmarried	Married	Total
0	37.98	62.02	100
1	32.87	67.13	100
Total	34.46	65.54	100

Table 27 represents the distribution of vulnerability to extreme poverty based on marital status. Here also, a higher percentage of married respondents are vulnerable to extreme poverty. About 33% of unmarried respondents are likely to be poor as against 67.13% of married respondents who are likely to be poor in the future. This proves that married people are more burdened than unmarried people.

Furthermore, the study estimated the number of people who are vulnerable to poverty with the upper poverty line as well. The Table 28 presents respondents who are vulnerable to poverty with regards to the upper poverty line

Table 28. Vulnerability to poverty (Upper poverty line).

Vulnerability	Freq.	Percent	Cum.
0	3	0.72	0.72
1	412	99.28	100
Total	415	100	

The table shows 412 respondents out of 415 representing 99.28% are vulnerable to poverty. This means that almost every respondent is vulnerable to poverty as far as the case study is concerned. Again, this is very alarming as almost all respondents are liable to poverty knowing well that poverty has so many consequences and cannot lead to development especially in the time where the UN through the SDGs is looking at zero poverty.

Table 29. Vulnerability to poverty (Gender).

Vulnerability	Female	Male	Total
0	33.33	66.67	100
1	43.93	56.07	100
Total	43.86	56.14	100

Table 29 shows the distribution of vulnerability to poverty based on gender. It can be inferred from the table that, again, interestingly male household respondents are vulnerable to poverty as compared to their female counterparts. 56.07 % of male respondents are vulnerable to extreme poverty while about 44% of females are vulnerable to poverty.

Table 30. Vulnerability to poverty (Education).

Vulnerability	No formal Education	Formal Education	Total
0	0	100	100
1	41.5	58.5	100
Total	41.2	58.8	100

The Table 30 represents the distribution of vulnerability to poverty based on education. Here also, just like extreme poverty case, it is surprising to observe that the percentage of vulnerability to poverty of those who do not have any form of education is less than those who have had some

form of education. From the table, 41.5% of respondents who have no form of education are liable to poverty as against about 58.5% of educated respondents being vulnerable to poverty. This is in contrast with the study of Azam & Imai, (2009) where it is those without education who are vulnerable to poverty.

Table 31. Vulnerability to poverty (Marital Status).

Vulnerability	Unmarried	Married	Total
0	66.67	33.33	100
1	34.22	65.78	100
Total	34.46	65.54	100

The Table 31 above represents the distribution of vulnerability to poverty based on marital status. Here also, a higher percentage of married respondents are vulnerable to poverty. About 34% of unmarried respondents are likely to be poor as against 65.78% of married respondents who are likely to be poor in the future.

Already, sea level rise is causing so much damages and consequently leading to poverty. The perspective of this study is looking at how people or more specifically coastal dwellers are vulnerable to poverty due to sea level rise in the future is situations remain the same. Poverty is a major problem that impedes development therefore if people are vulnerable to poverty in the future, then development processing may slow down as well. The major limitation to realizing this objective was calculating the annual income. The respondents usually are paid by day and not monthly. They are days they may not work in which they may not be paid. Others do not have permanent jobs while others have side jobs as well. There were others who would not also truly indicate their incomes. All these make it difficult to estimate the correct income levels. The study therefore resorted to group income levels which may not be the best representation of respondents' income

3.5. Conclusion and Recommendation.

The study set out to find estimates of the vulnerability of coastal dwellers to poverty in the light of climate induced flooding. Specifically, the study sought to evaluate the factors that influence one's vulnerability to poverty as well as estimate the percentage of people vulnerable to poverty. It is important to begin by saying that climate change is not hypothetical. People are

experiencing effects including those living in coastal areas which influence poverty. The results of the analysis suggest that factors that influence vulnerability to poverty include; age, livelihood activities respondents engage in, the town of abode, marital status, hours spent at work, being displaced by sea level rise, losing properties due to sea level rise. Notably, the factors influencing vulnerability to extreme poverty are not so statistically different from factors that influence vulnerability to poverty with the upper poverty. It is estimated that for vulnerability to extreme poverty case, about 69% of respondents are vulnerable which is alarming. Again, in terms of gender, most men are more vulnerable as compared to females who are vulnerable while in the case of education, people with formal education have high number of people who are vulnerable in comparison to people without any formal education. However, there are higher percentage of married people who are vulnerable to poverty compared to the percentage of unmarried people who are vulnerable to poverty. Furthermore, in terms of vulnerability to poverty in terms of the use of the upper poverty line, about 99% of respondents are vulnerable to poverty. Under that, more percentage of men are vulnerable to poverty as compared to the percentage of females that are vulnerable. Again, here also, higher percentage of educated people are vulnerable to poverty as compared to the percentage of people who are not educated. Nonetheless, there is a high percentage of people who are married that vulnerable to poverty in comparison to the percentage of unmarried persons that are vulnerable to poverty.

The study recommends that the government and respective authorities would put much concentration on the effects that flooding associated with sea level rise is having on the people of the coastal areas with inhabit a huge number of people. There should be policies plans and strengthening of existing policy plans which would enhance effective coping mechanism as well as resilience. These would help reduce poverty as well as vulnerability to poverty. The limitation of the study majorly obtaining income values of respondents. This makes it difficult in estimating the correct income levels and consequently the vulnerability values.

Conclusion and Recommendation

This dissertation sought to the economic impact of sea level rise on coastal livelihood in Ghana. Specifically, the study aimed at examining the perceptions and coping capabilities of coastal dwellers of sea level rise, assessing the cost of sea level rise to coastal livelihood by calculating their willingness to pay and measuring the vulnerability to poverty as a result of sea level rise. On the first objective about perception and coping capabilities, the results obtained from this study confirm the literature including Taguiam and Quiambo-Marquez, Alcantara, et al., (2016; 2022) that the sea levels are rising and it's already affecting the wellbeing of people. From the various results, it is clear that sea level rise is not a hearsay, an illusion or a misconception but a case reality and almost everyone around the cost is aware of it. From the case study area, about 91% of the respondents are aware that the sea levels are rising and this is in accordance with literature including (Alcantara, et al., 2022). Coastal residents are aware that climate change is the cause of sea level rise. At least, the results have shown that over half of the respondents which represent the majority believe climate change to be the cause of the rise in sea levels. The results have shown that, knowledge sea level rise is being influenced by town of Abode, the annual income levels of individual, the displacement of individuals, the number of persons in a household and the number of days individual work. In the same way, the knowledge of climate change as the cause of sea level rise is significantly influenced by the town of Abode, the hours one works, the livelihood activity, the ability to cope and the annual income earned. Again, a household's ability to cope is influenced by age, the number of people in their household, the town they live in and their income

On the second objective two of estimating the cost of sea level rise through willingness to pay for insurance packages, it was found out that, all the attributes of the insurance packages are influential to choosing a package or not. Generally, the decision of a respondent to make choice or to not choose an insurance package is based on the attributes of the package (premium, information and claim) as well as the gender, awareness of sea level rise, coping capability and displacement. For the estimation of willingness to pay, the study found that the willingness to pay for all respondents bases on information as an attribute of insurance is approximately GHC 189 while the willingness to pay for premium based on claim is approximately GHC 1,025. The average total willingness to pay for all the packages is GHC 1,830 while the total willingness to

pay considering the whole population is GHC 2,688,270 respectively. Again, men have higher willingness to pay as compared to women.

Finally, the last specific objective on measuring vulnerability to poverty, factors that influence vulnerability to poverty include; age, livelihood activities respondents engage in, the town of abode, marital status, hours spent at work, being displaced by sea level rise, losing properties due to sea level rise. About 99% of respondents are vulnerable to poverty while about 69% of respondents are vulnerable to extreme poverty. In all cases, educated people have higher percentage of people who are vulnerable as compared to people with no formal education. Again, men have higher percentage of people who are vulnerable to poverty as compared to women. Moreover, married people have a higher percentage of people who are vulnerable in comparison to unmarried people.

The study recommends that the government and respective authorities would put much concentration on the effects that flooding associated with sea level rise is having on the people of the coastal areas which inhabit a huge number of people. There should be policies, plans and strengthening of existing policy plans which would enhance effective coping mechanisms as well as resilience. Insurance policies could be one way to help enhance coastal dwellers' coping capabilities as well as their resilience as the study has suggested that people are willing to pay for them. The government could subsidize the prices for effectiveness. This will go a long way to reduce poverty as well as vulnerability to poverty. This dissertation acknowledges limitations of difficulty in communicating objectives and asking questions in the language the lay people understand especially when most respondents have no formal education. Again, it was a challenging getting respondents to give an estimate of annual income. And finally, there were some inconsistencies in the choices across various choice sets.

References

- Abeygunawardena, P. et al., 2004. Poverty and climate change: Reducing the vulnerability of the poor through adaptation.
- Abrate, G. et al., 2016. A choice experiment on the willingness of households to accept power outages. *Utilities Policy*, 12. Volume 43.
- Adamowicz, W., Boxall, P. & Louviere, J., 1998. Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. *American journal of Agricultural Economics*, 80(1), pp. 64-75.
- Adamowicz, W., Louviere, J. & Williams, M., 1994. Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. *Journal of Environmental Economics and Management*, 26(3), pp. 271-292.
- Addo, K. A. & Adeyemi, M., 2013. Assessing the impact of sea-level rise on a vulnerable coastal community in Accra, Ghana. *Jàmbá: Journal of Disaster Risk Studies*, 5(1), pp. 1-8.
- Addo, K. A. & Adeyemi, M., 2013. Assessing the impact of sea-level rise on a vulnerable coastal community in Accra, Ghana. *Jàmbá: Journal of Disaster Risk Studies*, 5(1), pp. 1-8.
- Addo, K. A., Larbi, L., Amisigo, B. & Ofori-Danson, P. K., 2011. Impacts of Coastal Inundation Due to Climate Change in a CLUSTER of Urban Coastal Communities in Ghana, West Africa. *Remote Sensing*, 07 09. pp. 2029-2050.
- Addo, K. A., Larbi, L., Amisigo, B. & Ofori-Danson, P. K., 2011. Impacts of Coastal Inundation Due to Climate Change in a CLUSTER of Urban Coastal Communities in Ghana, West Africa. *Remote Sensing*, 07 09, 3(9), pp. 2029-2050.
- Adger, N. W., 2001. Scales of governance and environmental justice for adaptation and mitigation of climate change. *Journal of International Development*, 10.13(7).
- Adger, W. N. et al., 2009. Are there social limits to adaptation to climate change?. *Climatic Change*, 93(3), pp. 335-354.
- Agbogah, K., 2016. *Ghana's Coast - hazards, planning, management, disaster response*. s.l.:Graphic Online.
- Ahmed, S. A. et al., 2011. Climate volatility and poverty vulnerability in Tanzania. *Global Environmental Change*, 21(1), pp. 46-55.
- Alcantara, L. et al., 2022. Perceptions of Climate Change, Sea Level Rise and Factors Affecting the Coastal Marine Ecosystem of Palawan, Philippines. *UCL Open: Environment Preprint*, 11 05.
- Alexander Kim S., Anthony, R. & G., M. T., 2012. Managed retreat of coastal communities: understanding responses to projected sea level. *Journal of Environmental Planning and Management*, Volume 55:4, pp. 409-433.

- Ali, E., Egbendewe, A. Y. G., Abdoulaye, T. & B., S. D., 2020. Willingness to pay for weather index-based insurance in semi-subsistence agriculture: evidence from northern Togo. *Climate Policy*.
- Ali, M. S. & Syfullah, K., 2017. Effect of sea level rise induced permanent inundation on the livelihood of polder enclosed beel communities in Bangladesh: people's perception. *Journal of Water and Climate Change*, 8(2), pp. 219-234.
- Ali, M. S. & Syfullah, K., 2017. Effect of sea level rise induced permanent inundation on the livelihood of polder enclosed beel communities in Bangladesh: people's perception. *Journal of Water and Climate Change*, 8(2), pp. 219-234.
- Allan, R. P. & Soden, B. J., 2008. Atmospheric warming and the amplification of precipitation extremes. *Science*, 321(5895), pp. 1481-1484.
- Allen, M. et al., 2019. Technical Summary: Global warming of 1.5° C. An IPCC Special Report on the impacts of global warming of 1.5° C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat.
- Alliance Resilience, 2010. Assessing resilience in social-ecological systems: workbook for practitioners (revised version 2.0).
- Alwang, J., Siegel, P. B. & Jorgensen, S. L., 2001. *Vulnerability: a view from different disciplines*, s.l.: s.n.
- Amemiya, T., 1977. The maximum likelihood and the nonlinear three-stage least squares estimator in the general nonlinear simultaneous equation model. *Econometrica: Journal of Econometric Society*.
- Amidu, I., 2016. Estimating the Economic Cost of Sea Level Rise on Low-Lying Coastal Properties in Accra, Ghana. p. 14.
- Anon., n.d.
- Anthoff, D., Nicholls, R. J. & Tol, R. S. J., 2010. The economic impact of substantial sea-level rise. *Mitigation and Adaptation Strategies for Global Change*, 01 04, Volume 15, pp. 321-335.
- Anthoff, D., Nicholls, R. J., Tol, R. S. J. & Vafeidis, A. T., 2006. *Tyndell Centre for Climate Change Research*. [Online]
Available at: http://www.tyndall.ac.uk/publications/working_papers/twp96.pdf
- Antilla, L., 2010. Self-censorship and science: a geographical review of media coverage of climate tipping points. *Public Understanding of Science*, 19(2), pp. 240-256.
- Antwi-Boasiako, B., 2016. Insurance and flood risk reduction in Ghana: do insurers penalise homeowners who take precautionary measures?. *Environmental Hazards*, 01 10, 15(4), pp. 343-335.
- Appiah-Kubi, K., D., O. A. & Senadza, B., 2008. Understanding poverty in Ghana: Risk and vulnerability.
- Armah, A. K. & Amlalo, D. S., 1998. *Accra: Ministry of Environment, Science and Technology*. Ghana. [Online].
- Arrow, K. J., 1969. The organization of economic activity: issues pertinent to the choice of market versus nonmarket allocation. Volume 1, pp. 59-73.

- Assan, J. K. & Kumar, P., 2009. Introduction: Livelihood options for the poor in the changing environment. *Journal of International Development: The Journal of the Development Studies Association*, 21 (3), pp. 393-402.
- Aven, T. & Renn, O., 2009. On risk defined as an event where the outcome is uncertain. *Journal of risk research*, 12(1), pp. 1-11.
- Azam, M. S. & Imai, K. S., 2009. Vulnerability to poverty in Bangladesh. *Chronic poverty research Centre Working paper*.
- Azeem, M. M., Muger, A. W. & Schilizzi, 2016b. Poverty and vulnerability in the Punjab, Pakistan: A multilevel analysis. *Journal of Asian Economics*, 06.
- Azeem, M. M., Muger, A. W. & Schilizzi, S., 2016a. Living on the edge: Household vulnerability to food-insecurity in the Punjab, Pakistan. *Food Policy*, pp. 1-13.
- Bah, A., 2013. Estimating Vulnerability to Poverty using Panel Data: Evidence from Indonesia. 01 10.
- Bamber, J. L. et al., 2019. Ice sheet contributions to future sea-level rise from structured expert judgment. *Proceedings of the National Academy of Sciences*, 116(23), pp. 11195-11200.
- Bane, M. a. E. D., 1986. Slipping into and out of poverty: The dynamics of spells. *The Journal of Human Resource*, 21(1), pp. 1-23.
- Barth, M. C. & Titus, J. G., 1984. Greenhouse effect and sea level rise: A challenge for this generation.
- Bartlett, J. E., Kotrlík, J. W. & Haggings, C. C., 2001. Organizational Research: Determining Appropriate Sample Size in Survey Research. *Information Technology, Learning, and Performance Journal*, 19(1).
- Beauchemin, C. & Bocquier, P., 2004. Migration and urbanisation in Francophone West Africa: An overview of the recent empirical evidence. *Urban Studies*.
- Bennett, J. & Blamey, R., 2001. *The choice modelling approach to environmental valuation*. s.l.:Edward Elgar Publishing.
- Bennett, J. & Morrison, M., 2001. Valuing the environmental attributes of NSW rivers.
- Bird, E. C. F., 1996. Coastal Erosion and Rising Sea Levels. In: J. D. Milliman & B. U. Haq, eds. *Sea-Level Rise and Coastal Subsidence: Causes, Consequences, and Strategies*. Dordrecht: Springer Netherlands, pp. 87-103.
- Black, R., Kniveton, D. & Schmidt-Verkerk, K., 2011. Migration and climate change: towards an integrated assessment of sensitivity.
- Blamey, R., Gordon, J. & Chapman, R., 1999b. Choice modelling: assessing the environmental values of water supply options. *Australian Journal of Agricultural and Resource Economics*, 43(3), pp. 337-357.
- Blamey, R. K., Bennet, J. W. & Morrison, M., 1999. Yea-saying in contingent valuation surveys. *Land Economics*.
- Blamey, R. K., Rolfe, J. C., W., B. J. & Morrison, M. D., 1997. Environmental choice modelling: issues and qualitative insights. *Choice Modelling research report*, Issue 4.

- Blamey, R., Rolfe, J., Bennett, J. & Morrison, M., 2000. Valuing remnant vegetation in Central Queensland using choice modelling. *Australian Journal of Agricultural and Resource Economics*, 44(3).
- Boateng, I., 2012. An assessment of the physical impacts of sea-level rise and coastal adaptation: a case study of the eastern coast of Ghana. *Climatic Change*, 114(2), pp. 273-293.
- Bohle, H., Downing, T. & Watts, M., 1994. Climate change and social vulnerability.. *Global Environmental Change*, Volume 4, pp. 37-48.
- Boholm, Å., 2009. Speaking of risk: Matters of context. *Environmental Communication* , 3(3), pp. 335-354.
- Bosello, F. & De Cian, E., 2014. Climate change, sea level rise, and coastal disasters. A review of modeling practices. *Energy Economics*, 11, Volume 46, pp. 593-605.
- Bosello, F. et al., 2012. Economic impacts of climate change in Europe: sea-level-rise. *Climatic Change*, 05, 112(1), pp. 63-81.
- Bosello, F. et al., 2021. Economic impacts of climate change in Europe: sea-level rise. *Climate Change*, 5.
- Bosello, F., Roson, R. & Tol, R. S. ..., 2007. Economic-wide Estimates of the Implications of Climate Change: Sea Level Rise. *Environmental and Resource Economics*, 29 05, 37(3), pp. 549-571.
- Boxall, P. C. et al., 1996. A comparison of stated preference methods for environmental valuation. *Ecological economics*, 18(3), pp. 243-253.
- Budhathoki, N. K., Lassa, J. A., Pun, S. & Zander, K. K., 2019. Farmers' interest and willingness-to-pay for index-based crop insurance in the lowlands of Nepal. *Land Use Policy*, 01 06, Volume 85, pp. 1-10.
- Burger, J., Gochfeld, M., Pittfield, T. & Jeitner, C., 2016. Perceptions of Climate Change, Sea Level Rise, and Possible Consequences Relate Mainly to Self-Valuation of Science Knowledge. *Energy Power Engineering*, 05.8(5).
- Burke, L. et al., 2001. *Coastal ecosystems*. s.l.:World Resources Institute Washington, DC.
- Cafasso, S., 2021. *Stanford News*. [Online]
Available at: <https://news.stanford.edu/2021/07/12/economic-impacts-combatting-sea-level-rise/>
- Canagarajah, S., Siegel, P. & Heitzmann, K., 2002. Guidelines for assessing the sources of risk and vulnerability.
- Care for Shelter, 2008. [Online].
- Carro, I. et al., 2018. Building capacity on ecosystem-based adaptation strategy to cope with extreme events and sea-level rise on the Uruguayan coast. *International Journal of Climate Change Strategies and Management*, 01 01, 10(4), pp. 504-522.
- Carvalho, A., 2010. Media (ted) discourses and climate change: a focus on political subjectivity and (dis) engagement. *Wiley Interdisciplinary Reviews: Climate Change*, 1(2).
- Castles, S., 2002. *Environmental change and forced migration: making sense of the debate*. s.l.:UNHCR.

- Chaudhuri, S., 2000. Empirical methods for assessing household vulnerability to poverty. *School of International and Public Affairs, Columbia University, New York*.
- Chaudhuri, S., 2003. Assessing vulnerability to poverty: concepts, empirical methods and illustrative examples. *Department of Economics, Columbia University, New York*.
- Chaudhuri, S., Jalan, J. & Suryahadi, A., 2002. Assessing household vulnerability to poverty from cross-sectional data: A methodology and estimates from Indonesia.
- Chaudhury, M., 2017. Strategies for reducing vulnerability and building resilience to environmental and natural disasters in developing countries. *United Nations Department of Economic and Social Affairs, Division of Social Policy and Development*.
- Chen, C.-C., McCarl, B. & Chang, C.-C., 2012. Climate change, sea level rise and rice: global market implications. *Climatic Change*, 02, 110(3-4), pp. 543-560.
- Chenkov-Shaw, G., 2019. *Climate Change: humanity's biggest externality*, s.l.: s.n.
- Christiaensen, 2004. *Measuring household vulnerability: conceptual issues and illustrative examples*. s.l., s.n.
- Christiaensen, L. J. & Boisvert, R. N., 2000. On measuring household food vulnerability: Case evidence from Northern Mali.
- Christiaensen, L. J. & Subbarao, K., 2005. Towards an understanding of household vulnerability in rural Kenya. *Journal of african economies*, 14 (4).
- Church, J. A. et al., 2010. Sea-level rise and variability: synthesis and outlook for the future. In: *Understanding sea-level rise and variability*. s.l.:Wiley-Blackwell.
- Church, J. A. et al., 2013. *Sea Level Change*, s.l.: PM Cambridge University Press.
- Church, J. A. & White, N. J., 2011. The Sea-Level Rise from the Late 19th Century to the Early 21st Century. *Surveys in Geophysics*, 09.32(4-5).
- Climate Change Science Program (US), 2008. *Weather and Climate Extremes in a Changing*, Washington, D.C.: U.S. Climate Change Science Program.
- Coase, R. H., 1969. The problem of social cost. In: *Classic papers in nature resource economics*. s.l.:Springer.
- Coastal Erosion | U.S. Climate Resilience Toolkit, 2021. [Online]
Available at: <https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion>
[Accessed 07 06 2022].
- Coastal Wiki, n.d. *Coastal Wiki*. [Online]
Available at: http://www.coastalwiki.org/wiki/Hard_coastal_protection_structures
- Combest-Friedman, C., Christie, P. & Miles, E., 2012. Household perceptions of coastal hazards and climate change in the Central Philippines. *Journal of Environmental Management*, 12, Volume 112, pp. 137-148.

- Committee on Climate Change (CCC), 2010. How well prepared is the UK for climate change?.
- Cook, J. et al., 2013. Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental research letters*, 8(2).
- Copenhagen Accord, 2009. *World Ocean Review*. [Online]
Available at: <https://worldoceanreview.com/en/wor-5/improving-coastal-protection/coping-with-rising-sea-levels/>
- Covi, M. & Kain, D., 2016. Sea-Level Rise Risk Communication: Public Understanding, Risk Perception, and Attitudes about Information.. *Environmental Communication*, Volume 10.
- Crichton, D., 2002. UK and global insurance responses to flood hazard. *Water International*, 27(1), pp. 119-131.
- Crichton, D., 2008b. Towards a comparison of public and private insurance responses to flooding risks. *International Journal of Water Resources Development*, 24(4), pp. 583-592.
- Crichton, D., 2008. Role of Insurance in Reducing Flood Risk. *The Geneva Papers on Risk and Insurance - Issues and Practice*, 01 01, 33(1), pp. 117-132.
- Crichton, D., 2018. The role of private insurance companies in managing flood risks in the UK and Europe. In: *Urban flood management*. s.l.:CRC Press, pp. 83-100.
- CSIR, 2020. *CSIR*. [Online].
- Cui, Q., Xie, W. & Liu, Y., 2018. Effects of sea level rise on economic development and regional disparity in China. *Journal of Cleaner Production*, 03. Volume 176.
- Cutter, S. L., Mitchell, J. T. & Scott, M. S., 2000. Revealing the vulnerability of people and places: A case study of Georgetown County, South Carolina. *Annals of the association of American Geographers*, 90(4), pp. 713-737.
- Dampha, N., 2020. Ecosystem Services and Coastal Adaptation to Climate Change: An Interdisciplinary Science-Based Application in The Gambia. 09.
- Darwin, R. F. & Tol, R. S. J., 2001. Estimates of the Economic Effects of Sea Level Rise. p. 18.
- Dasgupta, S. et al., 2009. The impact of sea level rise on developing countries: a comparative analysis. *Climatic Change*, 04. Issue 3-4.
- Davoudi, S. et al., 2012. Resilience: a bridging concept or a dead end?“Reframing” resilience: challenges for planning theory and practice interacting traps: resilience assessment of a pasture management system in Northern Afghanistan urban resilience. *Planning theory & practice*, 13(2).
- Deke, O. et al., 2001. *Economic impact of climate change: Simulations with a regionalized climate-economy model*, s.l.: s.n.
- Diaz, D. B., 2016. Estimating global damages from sea level rise with the Coastal Impact and adaptation Model (CIAM). *Climatic Change*, 01 07, 137(1-2)(1), pp. 143-156.

- Dietz, S. & Venmans, F., 2019. Cumulative carbon emissions and economic policy: in search of general principles. *Journal of Environmental Economics and Management*, Volume 96, pp. 108-129.
- Dixon, L., Clancy, N., Seabury, S. A. & Overton, A., 2006. The National Flood Insurance Program's market penetration rate: Estimates and policy implications. *Santa Monica, CA: RAND Corporation*.
- Dovie, D., Nyamedor, F. & Anwana, E., 2014. *Building coastal resilience through an integrated approach: Lessons from Ghana*. s.l.:s.n.
- Dubbelboer, J., Nikolic, I., Jenkins, K. & Hall, J., 2017. An agent-based model of flood risk and insurance. *Journal of Artificial Societies and Social Simulation*, 31 01.20(1).
- Egbendewe-Mondzodzo, A., Haggins, L. M. & Shaw, W. D., 2010. Red-light cameras at intersections: Estimating preferences using a stated choice model. *Transportation research part A: policy and practice*.
- Ehsan, S., 2016. *Willingness to Pay for Adaptation Measures to Sea Level Rise: The Case of Coastal Areas in Batu Pahat District, Johor, Malaysia*. s.l., s.n.
- Elbers, C. & Gunning, J. W., 2003. Vulnerability in a stochastic dynamic model.
- Endalew, B., Tassie, K. & Ayalew, Z., 2019. Non-Market Measurement Techniques of Willingness to Pay, the Case of Environmental Resources: A Review.
- Entorf, H. & Jensen, A., 2020. Willingness-to-pay for hazard safety – A case study on the valuation of flood risk reduction in Germany. *Safety Science*, Volume 128.
- EPA-US, 2010. *United States Environmental Protection Agency*. [Online]
Available at: [Office of Air and Radiation \(6207J\) EPA 430-F-10-002 www.epa.gov/climatechange](https://www.epa.gov/climatechange)
- Eriksen, S. H. & O'Brien, K., 2011. Vulnerability, poverty and the need for sustainable adaptation measures. *Climate Policy*, 15 06.
- Eriksen, S. & O'Brien, K., 2007. Vulnerability, poverty and the need for sustainable adaptation measures. *Climate Policy*, Volume 7, pp. 337-352.
- Feeny, S. & McDonald, L., 2016. Vulnerability to Multidimensional Poverty: Findings from Households in Melanesia. *The Journal of Development Studies*, 03 03.
- Feldman, A. M. & Serrano, R., 2006. *Welfare Economics, and social Choice*. 2 ed. s.l.:Springer US.
- FEMA, 2021. *Flood Insurance | FEMA.gov*. [Online]
Available at: <https://www.fema.gov/flood-insurance>
- Field, C. B. et al., 2014. *Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. s.l.:Cambridge University Press.
- Fiorino, D. J., 1990. Citizen participation and environmental risk: A survey of institutional mechanisms. *Science, Technology, & Human Values*, 15(2), pp. 226-243.
- Fischhoff, B., 1995. Risk communication and perception unplugged: twenty years of process. *Risk Analysis*, 15(2).

- Fischhoff, B. et al., 1978. How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy sciences*, 9(2).
- Forrey, S. & Gray, E., 2021. NASA. [Online]
Available at: <http://nasa.gov/specials/sea-level-rise-2020>
- Fujii, T., 2016. Concepts and measurement of vulnerability to poverty and other issues: a review of literature.. *The Asian Poverty Miracle*, pp. 53-83.
- Fu, X., Song, J., Sun, B. & Peng, Z.-R., 2016. "Living on the edge": Estimating the economic cost of sea level rise on coastal real estate in the Tampa Bay region, Florida. 12, Volume 133, pp. 11-17.
- Gallardo, M., 2018. Identifying Vulnerability to Poverty: A Critical Survey. *Journal of Economic Surveys*, 32(4).
- Gallup Organization (GO) Environment, 2013. *Gallup Organization (GO) Environment*. [Online]
Available at: <http://gallup.com/poll/1615/environment.aspx>
- Garza-Rodriguez, J., 2018. *Social Science*, 7(10), p. 183.
- Gittman, R. K. et al., 2015. Engineering away our natural defenses: an analysis of shoreline hardening in the US. *Frontiers in Ecology and the Environment*, 13(6), pp. 301-307.
- GLSS, 2017. *Ghana - Ghana Living Standard Survey*. [Online]
Available at: <https://www2.statsghana.gov.gh/nada/index.php/catalog/97>
- Guber, D. L., 2013. A cooling climate for change? Party polarization and the politics of global warming. *American Behavioural Scientist*, 57(1), pp. 93-115.
- Gunther, I. & Harttgen, K., 2006. Households' Vulnerability to Covariate and Idiosyncratic Shocks. 01 02.
- Haas, J., Merkl, A., Kennes, W. & Bresch, D. N., 2009. *Shaping Climate-Resilient Development: A Framework for Decision-Making: A Report of the Economics of Climate Adaptation Working Group*, s.l.: s.n.
- Hallegatte, S., 2016. *Shock waves: managing the impacts of climate change on poverty*. s.l.:World Bank Publications.
- Hallegatte, S. & Rozenberg, J., 2017. Climate change through a poverty lens. *Nature Climate Change*, 04, 7(4), pp. 250-256.
- Hallegatte, S., Vogt-Schilb, A., Bangalore, M. & Rozenberg, J., 2016. *Unbreakable: building the resilience of the poor in the face of natural disasters*. s.l.:World Bank Publications.
- Hamukawa, P., Oparinde, A. & Binswanger-Mkhize, H. P., 2019. Design factors influencing willingness-to-pay estimates in the Becker-DeGroot-Marschak (BDM) mechanism and the non-hypothetical choice experiment: A Case of biofortified maize in Zambia. *Journal of Agricultural Economics*, 70(1), pp. 81-100.
- Handwerger, L. R., Sugg, M. M. & Runkle, J. D., 2021. Present and future sea level rise at the intersection of race and poverty in the Carolinas: A geospatial analysis. *The Journal of Climate Change and Health*, 08. Volume 3.

- Hanemann, W. M., 1984. Welfare evaluations in contingent valuation experiments with discrete responses. *American journal of agricultural economics*, 66(3), pp. 332-341.
- Hanemann, W. M., 1991. Willingness to Pay and Willingness to Accept: How Much They Differ?. *The American Economic Review*, 81(3), pp. 635-6747.
- Hanley, N., Mourato, S. & Wright, R. E., 2002. Choice Modelling Approaches: A Superior Alternative for Environmental Valuation?. *Journal of Economics Surveys*, 16 12.15(3).
- Hanley, N. S. J. F. & White, B., 2007. *The Environmental Economic: in theory and practice*. s.l.:Palgrave Macmillan.
- Hanley, N., Wright, R. E. & Adamowicz, V., 1998. Using choice experiments to value the environment. *Environmental and resource economics*, 11(3), pp. 413-428.
- Hanson, S. et al., 2011. A global ranking of port cities with high exposure to climate extremes. *Climatic Change*, 01 01.104(1).
- Harris, J., Roach, B. & Codur, A.-M., 2017. *The economics of global climate change*. s.l.:Global Development And Environment Institute Tufts University.
- Hartman, R. S., Doane, M. J. & Woo, C.-K., 1991. Consumer Rationality and the Status Quo*. *The Quarterly Journal of Economics*, 106(1).
- Harvatt, J., Petts, J. & Chilvers, J., 2010. Understanding householder responses to natural hazards: flooding and sea-level rise comparisons. *Journal of Risk Research*.
- Harvey, N. & Caton, B., 2003. Coastal Management in Australia.
- Hasell, J., Roser, M., Ortiz-Ospina, E. & Arriagada, P., 2022. Poverty. *Our World in Data*, 17 10.
- Hauer, M. E., 2017. Migration induced by sea-level rise could reshape the US population landscape. *Nature Climate Change*.
- Heinzerling, L., 2012. Climate Change at EPA. *Fla. L. Rev*, Volume 64, p. 1.
- Hensher, D. A., Rose, J. M. & Greene, W. H., 2005. *Applied choice analysis: a primer*. s.l.:Cambridge university press.
- Herrera, C., Ruben, R. & Dijkstra, G., 2018. Climate variability and vulnerability to poverty in Nicaragua. *Journal of Environmental Economics and Policy*, 09 02.
- Hinkel, J. et al., 2015. The Sea-level rise scenarios and coastal risk management. *Nature Climate Change*, 03, 5(3), pp. 188-190.
- Hinkel, J. et al., 2014. Coastal flood damage and adaptation costs under 21st century sea-level rise. *Proceedings of the National Academy of Sciences*, 111(9), pp. 3292-3297.
- Hinkel, J. et al., 2014. Coastal flood damage and adaptation costs under 21st century sea-level rise. *Proceedings of the National Academy of Sciences*, Volume 26(2), pp. 157-170.

- Hinkel, J. et al., 2010. Assessing risk of and adaptation to sea-level rise in the European Union: an application of DIVA. *Mitigation and adaptation strategies for global change*, 15(7), pp. 703-719.
- Hochrainer-Stigler, S. et al., 2020. Standardized disaster and climate resilience grading: A global scale empirical analysis of community flood resilience. *Journal of Environmental Management*, 12, Volume 279, p. 111332.
- Hoddinot, J. & Quisumbing, M. A. R., 2003. *Data sources for microeconomic risk and vulnerability assessments*. s.l.:Citeseer.
- Hoegh-Guldberg, O. et al., 2018. *Impacts of 1.5°C Global Warming on Natural and Human Systems*, s.l.: s.n.
- Holzmann, R., 2001. *Risk and vulnerability: the forward looking role of social protection in a globalizing world*. s.l.:World Bank Washington, DC.
- Holzmann, R. & Jorgensen, S., 2000. Social Risk Management: A New Conceptual Framework for Social Protection and Beyond. Social Protection Unit. *Human Development Network, the World Bank, Washington, Social Protection Discussion Paper Series*, Issue 6.
- Horowitz, A. D., 2013. The Effects of Sea Level Rise on Historic Districts and the Need for Adaptation.
- Hsiang, S. et al., 2017. Estimating economic damage from climate change in the United States. 30 07, 365(6345), pp. 1362-1369.
- Hudson, P., Botzen, W. J. W. & Aerts, J. C. J. H., 2019. Flood insurance arrangements in the European Union for future flood risk under climate and socioeconomic change. *Global Environmental Change*, Volume 58.
- Hulme, M., 2008. The conquering of climate: discourses of fear and their dissolution. *Geographical Journal*, 174(1).
- Hulme, M., 2009. *Why we disagree about climate change: Understanding controversy, inaction and opportunity*. s.l.:Cambridge University Press.
- Ibarrarán, M. E., Malone, E. L. & Brenkert, A. L., 2010. Climate change vulnerability and resilience: current status and trends for Mexico. *Environment, Development and Sustainability*, 12(3).
- Idso, C. D., 2014. S. Fred Singer and the Nongovernmental International Panel on Climate Change. *Energy & Environment*, 25(6-7).
- Ignatius, A., 2012. Spatial vulnerability of rural households to CC in Nigeria: Implications for internal security.
- Imai, K., Gaiha, R. & Kang, W., 2011. Vulnerability and poverty dynamics in Vietnam. *Applied Economics*, 01 10, 43(25), pp. 3603-3618.
- IPCC, 1997. The regional impacts of climate change: an assessment of vulnerability. *IPCC, Geneva*.
- IPCC, 2007. [Online]
Available at: <https://www.ipcc.ch/report/ar4/syr/>

- IPCC, 2013. *AR5 Climate Change 2013: The Physical Science Basis* — IPCC, s.l.: IPCC.
- IPCC, 2014. *AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability* — IPCC, s.l.: s.n.
- IPCC, 2015. [Online]
Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/drafts/fd/WGIIAR5-Chap13_FGDall.pdf?cfchlcaptcha=tk%3DpmdI5km2I.zqG3HIMx6SgW1cPkTlq5sXgjQv7LHUeeU8Ak-1631717682-0-gqNtZGzNAxCicnBszQj9
- IPCC, 2018. *Global Warming of 1.5 C, Special Report. Summary for Policymakers*. s.l.:WMO, UNEP, Suiza.
- Jallow, B. P., Barrow, M. K. & P., L. S., 1996. Vulnerability of the coastal zone of The Gambia to sea level rise and development of response strategies and adaptation options. *Climate Research*.
- Jamal, H., 2009. Assessing vulnerability to poverty: evidence from pakistan.
- Jennings, S. & Courtney, Q., 2016. Public Perception of Sea Level Rise Risk: A Case Study of Charleston, South Carolina.
- Jevrejeva, S. et al., 2018. Flood damage costs under the sea level rise with warming of 1.5 °C and 2 °C. *Environmental Research Letters*, 01 07.13(7).
- Jha, R., Dang, T. & Tashrifov, Y., 2010. Economic vulnerability and poverty in Tajikistan. *Economic Change and Restructuring*, 43(2), pp. 95-112.
- Jiménez, J. A. et al., 2017. Impacts of sea-level rise-induced erosion on the Catalan coast. *Regional Environmental Change*, 01 02, 17(2), pp. 593-603.
- Kaha, D. M., Paul, S., Barman, D. & Gastil, J., 2006. Fear of Democracy: A Cultural Evaluation of Sunstein on Risk. *The Harvard Law Review*, 119(4).
- Kahan, D., 2013. Making climate-science communication evidence-based. *Culture, politics and climate change: How information shapes our common future*.
- Kahan, D. M., Jenkins-Smith, H. & Braman, D., 2011. Cultural cognition of scientific consensus. *Journal of risk research*, 14(2), pp. 147-174.
- Kahan, D. M. et al., 2012. The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change*, 2(10), pp. 732-735.
- Kamaludin, m., Azlina, A., Padli, J. & Aliphiah, R., 2018. Assessing Public's Preferences and Willingness to Pay for Flood Prevention Program in Kuala Krai, Malaysia. *Disaster Advances*, Volume 11, pp. 1-10.
- Kamanou, G. & Morduch, J., 2004. Measuring Vulnerability to Poverty. In: S. Dercon, ed. *Insurance Against Poverty*. 1 ed. s.l.:Oxford University Press, pp. 155-175.
- Karegar, M. A. et al., 2017. Nuisance Flooding and Relative Sea-Level Rise: the Importance of Present-Day Land Motion. *Scientific Reports*, 11 09, 7(1), p. 11197.
- Kasperson, R. E. & Kasperson, J. X., 1996. The social amplification and attenuation of risk. *The annals of the American academy of political and social science*, pp. 95-105.

- Kasperson, R. E. et al., 1988. The social amplification of risk: A conceptual framework. *Risk analysis*, 8(2), pp. 177-187.
- Kebede, A. S. & Nicholls, R. J., 2011. *Population and assets exposure to coastal flooding in Dar es Salaam (Tanzania): vulnerability to climate extremes*, s.l.: s.n.
- Kitolelei, J. V. & Sato, T., 2016. Analysis of perceptions and knowledge in managing coastal resources: a case study in Fiji. *Frontiers in Marine Science*, Volume 3.
- Koerth, J., Vafeidis, A. T., Hinkel, J. & Sterr, H., 2013. What motivates coastal households to adapt proactively to sea-level rise and increasing flood risk?. *Regional Environmental Change*, 01 08, 13(4), pp. 897-909.
- Kousky, C., Fleming, B. & Berger, A. M., 2021. *A Blueprint for Coastal Adaptation: Uniting Design, Economics, and Policy*. s.l.:Island Press.
- Kousky, C. & Kunreuther, H., 2010. Improving flood insurance and flood-risk management: insights from St. Louis, Missouri. *Natural Hazards Review*, 11(4), pp. 162-172.
- Kron, W., 2009. Flood insurance: from clients to global financial markets: Flood insurance. *Journal of Flood Risk Management*, 03.2(1).
- Kron, W., 2013. Coast: the high-risk areas of the world. *Natural Hazards*, 01 04, 66(3), pp. 1363-1382.
- Kulp, S. A. & Strauss, B. H., 2019. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communication*, Volume 10, p. 4844.
- Kwak, K., Wang, P. & Louviere, J. J., 2016. A novel approach to detect attribute by covariate interactions in discrete choice models. *Journal of choice modelling*, Volume 21, pp. 42-47.
- Kwak, S. & Smith, S. C., 2011. Multidimensional poverty and interlocking poverty traps: framework and application to Ethiopian household panel data.. *Institute for International Economic Policy Working Paper Series*.
- Laffont, J.-J., 1989. Externalities. In: *Allocation, information and markets*. s.l.:Springer, pp. 1112-1116.
- Lancaster, K. J., 1966. A new approach to consumer theory. *Journal of political economy*, 74(2), pp. 132-157.
- Landau, K., Klasen, S. & Zucchini, W., 2012. *Measuring vulnerability to poverty using long-term panel data*, s.l.: Deutsches Institut für Wirtschaftsforschung (DIW), Berlin.
- Leatherman, S. P., 2001. Social and economic costs of sea level rise. In: *International Geophysics*. s.l.:Elsevier, pp. 181-223.
- Leichenko, R. & Silva, J. A., 2014. Climate change and poverty: vulnerability, impacts and alleviation strategies. *WIREs Climate Change*, 5(4), pp. 539-556.
- Leiserowitz, A. A., 2005. American risk perceptions: Is climate change dangerous?. *Risk Analysis: An International Journal*, 25(6).

Leiserowitz, A. et al., 2021. *International Public Opinion on Climate Change*, s.l.: Yale program on Climate Change Communication.

Leiserowitz, A. et al., 2012. *Climate change in the American mind: Americans' global warming beliefs and attitudes*, s.l.: Yale University and George Mason University..

Leiserowitz, A., Marlon, J. H. P., Mildenerger, M. & Zhang, B. W. X., 2018. *Yale Program on Climate Change Communication*. [Online]

Available at: <http://climatecommunication.yale.edu/visualizations-data/ycom-us-2018>

Leiss, W., 1996. Three phases in the evolution of risk communication practice. *The Annals of the American Academy of Political and Social Science*, Issue 1, pp. 85-94.

Ligetti, E., Penny, J. & Wieditz, I., 2007. Cities preparing for climate change.. *Clean Air Partnership*.

Ligon, E. & Schechter, L., 2003. Measuring Vulnerability. *The Economic Journal*.

Linares, P. C., 2012. Sea level rise impacts in coastal zones: Soft measures to cope with it. *Dalhousie Journal of Interdisciplinary Management*, 05 04.8(2).

Linnekamp, F., Koedam, A. & Baud, I. S. A., 2011. Household vulnerability to climate change: Examining perceptions of households of flood risks in Georgetown and Paramaribo. *Habitat International*, 01 07, 35(3), pp. 447-456.

Liu, J., 2011. The Cancun Agreements. *Environmental Law Review*, 13(1), pp. 43-49.

Liu, X., Tang, Y., Ge, J. & Miranda, M. J., 2019. Does experience with natural disasters affect willingness-to-pay for weather index insurance? Evidence from China. *International Journal of Disaster Risk Reduction*, Volume 33, pp. 33-43.

Lloyds, 2006. *Climate change; adapt or bust, London*, s.l.: Insurance Information Institute, New York, Lighthill Risk Network, London., Lloyd's Market Association, London (360 Degree Risk Project).

Louviere, J., Hensher, D. A. & Swait, J. D., 2000. *Stated choice methods: analysis and applications*. s.l.:Cambridge University Press.

Louviere, J. J. & Hensher, D. A., 1982. On the design and analysis of simulated choice or allocation experiments in travel choice modelling. *Transportation research record*, 890(1), pp. 11-17.

Louviere, J. J. & Woodworth, G., 1983. Design and analysis of simulated consumer choice or allocation experiments: an approach based on aggregate data. *Journal of marketing research*, 20(4), pp. 350-367.

Luo, S. et al., 2015. Adaptive measures adopted for risk reduction of coastal erosion in the People's Republic of China. *Ocean & Coastal Management*, Volume 103, pp. 134-145.

Maddison, D., 2007. The perception of and adaptation to climate change in Africa. Volume 4308.

Mansi, E., Hysa, E., Panait, M. & Voica, M. C., 2020. Poverty—A Challenge for Economic Development? Evidences from Western Balkan Countries and the European Union. *Sustainability*, 01, 12(18), p. 7754.

Mansuri, G. & Healy, A., 2000. Assessing vulnerability: an ex ante measure and its application using data from rural Pakistan. *Development Research Group, The World Bank, Washington DC*.

- Markowitz, E. M. & Shariff, A. F., 2012. Climate Change and moral judgement. *Nature Climate Change*, 2(4).
- Marschak, J., 1960. *Binary choice constraints on random utility indications In: Arrow K, editor. s.l., s.n.*
- Martínez, M. L., Hesp, P. & Gallego-Fernández, J. B., 2013. Coastal dunes: human impact and need for restoration. In: *Restoration of coasta dunes. s.l.:Springer*, pp. 1-14.
- Marx, S. M. et al., 2007. Communication and mental processes: Experiential and analytic processing of uncertain climate information. *Global Environmental Change*, 17(1).
- McCarthy, J., 2020. *Global Citizen*. [Online]
Available at: <https://www.globalcitizen.org/en/content/how-climate-change-affects-women/>
- McCarthy, J. J. et al., 2001. *Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change. s.l.:Cambridge University Press.*
- McCright, A. M. & Dunlap, R. E., 2010. Anti-reflexivity. *Theory, Culture & Society*, 27(2-3), pp. 100-133.
- McFadden, D., 1973. Conditional logit analysis of qualitative choice behavior.
- McGowan, S. A. & Baker, R. G., 2014. How past sea-level changes can inform future planning: A case study from the Macleay River estuary, New South Wales, Australia. *The Holcene*, 24(11), pp. 1591-1601.
- McGranahan, G., Balk, D. & Anderson, B., 2007. The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. *Environmental and Urbanization*, 19(1), pp. 17-37.
- Mcgranahan, G., Balk, D. & Anderson, B., 2007. The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones.. *Environment & Urbanisation*, 19(1).
- McLeman, R. A., 2014. *Climate and human migration: Past experiences, future challenges. s.l.:Cambridge University Press.*
- McLeman, R. & Smith, B., 2006. Migration as an Adaptation to Climate Change. *Climatic Change*, 01 05.
- Mehedintu, A., Soava, G. & Sterpu, M., 2019. The effect of remittances on poverty in the emerging countries of the European Union. *Sustainability*, 11(12), p. 3265.
- Mendelsohn, R., 2006. The role of markets and governments in helping society adapt to a changing climate. *Climatic Change*, 78(1), pp. 203-215.
- Mentaschi, L. et al., 2018. Global long-term observations of coastal erosion and accretion. *Scientific reports*, 8(1), pp. 1-11.
- Michael, J. A., 2007. Episodic flooding and the cost of sea level rise. *Ecological Economics*, p. 11.
- Millar, R., Allen, M., Rogeli, J. & Friedlingstein, P., 2016. The cumulative carbon budget and its implications. *Oxford Review of Economic Policy*, 32(2), pp. 323-342.
- Mima, S. & Criqui, P., 2011. The Costs of Climate Change for the European Energy System, an Assessment with the POLES Model. p. 31.

- Mimura, N., 2013. Sea-level rise caused by climate change and its implications for society. 25 07.pp. 281-301.
- Mitchell, R. C. & Carson, R. T., 2013. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. New York: RFF Press.
- Montero, O. P. & Batista, C. M., 2020. Social perception of coastal risk in the face of hurricanes in the southeastern region of Cuba. *Ocean & Coastal Management*, 02. Volume 184.
- Monterroso, A. & Conde, C., 2015. Exposure to climate and climate change in Mexico.. *Geomatics, Natural Hazards, and Risk*, 6(4), p. 272–288.
- Morduch, J., 1997. Poverty and Vulnerability. *American Economic Review* , 84(2), pp. 221-225.
- Moser, C. O., 1998. The asset vulnerability framework: reassessing urban poverty reduction strategies. *World Development*, pp. 1-19.
- Moser, S. C., 2010. Communicating climate change: history, challenges, process and future directions. *Wiley Interdisciplinary Reviews: Climate Change*, 1(1), pp. 31-53.
- Moser, S. C. & Dilling, L., 2004. Making climate hot. *Environment: Science and Policy for Sustainable Development*, 46(10), pp. 32-46.
- Moser, S. C. & Ekstrom, J. A., 2010. A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences*, 21 12.107(51).
- Mucova, S. A. R. et al., 2021. Approaching Sea-Level Rise (SLR) Change: Strengthening Local Responses to Sea-Level Rise and Coping with Climate Change in Northern Mozambique. *Journal of Marine Science and Engineering*, 02, 9(2), p. 205.
- National Geographic Society, 2019. *National Geographic Society*. [Online]
Available at: <http://www.nationalgeographic.org/encyclopedia/sea-level-rise/>
- National Geographic Society, 2011. [Online].
- Naudé, W., A., S.-P. & M., M., 2009. Measuring vulnerability: an overview and introduction. *Oxf Dev Stud*, Volume 37, pp. 183-191.
- Navarro, O. et al., 2021. Coping Strategies Regarding Coastal Flooding Risk in a Context of Climate Change in a French Caribbean Island. *Environment and Behavior*, 53(6), pp. 636-660.
- NCCAS, 2012. *PreventionWeb*. [Online]
Available at: <https://www.preventionweb.net/publication/ghana-national-climate-change-adaptation-strategy>
[Accessed 18 7 2022].
- Neumann, J. E. et al., 2015. Joint effects of storm surge and sea-level rise on US Coasts: new economic estimates of impacts, adaptation, and benefits of mitigation policy. *Climatic Change*, 129(1), p. 129.
- Newell, B. R. & Pitman, A. J., 2010. The psychology of global warming: Improving the fit between the science and the message. *Bulletin of the American Meteorological Society*.

- Nguyen, N. T. F. D. A. et al., 2022. Maximising resilience to sea-level rise in urban coastal ecosystems through systematic conservation planning. *Landscape and Urban Planning*, Volume 221, p. 104374.
- Nicholls, R. J., 2011. Planning for the Impacts of Sea Level Rise. 24(2), pp. 144-157.
- Nicholls, R. J. & Cazenave, A., 2010. Sea-Level Rise and Its Impact on Coastal Zones. *Science*, 18 06, 328(5985), pp. 1517-1520.
- Nicholls, R. J. et al., 2014. Sea-level scenarios for evaluating coastal impacts. *Wiley Interdisciplinary Reviews: Climate Change*, 5(1), pp. 129-150.
- Nicholls, R. J., Hoozemans, F. M. J. & Marchand, M., 1999. Increasing flood risk and wetland losses due to global sea-level rise: regional and global analyses. *Global Environmental Change*, Volume 9.
- Nicholls, R. J. & Kebede, A. S., 2012. Indirect impacts of coastal climate change and sea-level rise: the UK example. *Climate Policy*, Volume 12.
- Nicholls, R. J. & Tol, R. S. J., 2006. Impacts and responses to sea-level rise: a global analysis of the SRES scenarios over the twenty-first century. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, pp. 1073-1095.
- NOAA, 2019. [Online]
Available at: <https://www.natureindex.com/institution-outputs/united-states-of-america-usa/national-oceanic-and-atmospheric-administration-noaa/5139073d34d6b65e6a00226d/Earth%20%20Environmental%20Sciences/Proceedings%20of%20the%20National%20Academy%20of%20Sciences%20o>
- Nordhaus, W., 2019. Climate Change: The Ultimate Challenge for Economics. *American Economic Review*, 01 06, 109(6), pp. 1991-2014.
- Novignon, J., Nonvignon, J., Mussa, R. & Chiwaula, L. S., 2012. Health and vulnerability to poverty in Ghana: evidence from the Ghana Living Standards Survey Round 5. *Health Economics Review*, 06 05, 2(1), p. 11.
- NRC, N. R. C., 2009. *Informing decisions in a changing climate*. s.l.:National Academic Press.
- Nussbaum, R., 2004. *Le rôle de l'assurance dans la gestion des risques d'inondations et de tempêtes*. Paris, s.n.
- NW, 1. L. S., Washington, S. 8. & Inquiries, D. 2. U.-4., 2012. *More Say There Is Solid Evidence of Global Warming*, s.l.: <https://www.pewresearch.org/politics/2012/10/15/more-say-there-is-solid-evidence-of-global-warming/>.
- Oliver-Smith, A., 2009. *Sea level rise and the vulnerability of coastal peoples: responding to the local challenges of global climate change in the 21st century*. s.l.:UNU-EHS.
- Oppenheimer, M. & Glavovic, 2019. IPCC. [Online]
Available at: <https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities/>

- Oppenheimer, M. et al., 2019. *Sea Level Rise and Implications for Low-lying Islands, Coasts and Communities*, s.l.: Intergovernmental Panel on Climate Change (IPCC) Special Report on the Ocean and Cryosphere.
- Parry, M. L. et al., 2007. *Climate change 2007-impacts, adaptation and vulnerability: Working group II contribution to the fourth assessment report of the IPCC*. s.l.:Cambridge University Press.
- Passeri, D. L. et al., 2018. Dynamic modeling of barrier island response to hurricane storm surge under future sea level rise. *Climate Change*, 149(3), pp. 413-425.
- Peng, X. & Lu, H., 2020. Research on property income inequality effect of fiscal finance. *Economies*, 8(2), p. 50.
- Perez, V. W. & Egan, J., 2016. Knowledge and Concern for Sea-Level Rise in an Urban Environmental Justice Community. *Sociological Forum*, 31(S1).
- Perry, R. W., Lindell, M. K. & Tierney, K. J., 2001. Facing the unexpected: Disaster preparedness and response in the United States.
- PER, V. R. A. K. O., 2000. Agricultural extension.
- Philip, D. & Rayhan, M. I., 2004. Vulnerability and Poverty: What are the causes and how are they related. *ZEF Bonn, center for Development Research, University of Bonn*.
- Pidgeon, N. F. & Beattie, J., 1998. *The psychology of risk and uncertainty*. s.l.:Blackwell Science, London.
- Pidgeon, N. et al., 2006. Risk, environment and technology. In: *Risk in Social Science*. s.l.:Oxford University Press.
- Pigou, A., 1924. *The economics of welfare*. 2 ed. London: Macmillan.
- Preston, B. L. et al., 2008. Mapping climate change vulnerability in the Sydney Coastal Councils Group. *Prepared for the Sydney Coastal Councils Group*.
- Priestley, R. K., Heine, Z. & Milfont, T. L., 2021. Public understanding of climate change-related sea-level rise. *PLOS ONE*, 16 07. Volume 167.
- Raimi, L., Akhuemonkhan, I. & Ogunjirin, O. D., 2015. Corporate Social Responsibility and Entrepreneurship (CSRE): antidotes to poverty, insecurity and underdevelopment in Nigeria. *Social Responsibility Journal*.
- Rakib, M. A. et al., 2019. An investigation of coastal vulnerability and internal consistency of local perceptions under climate change risk in the southwest part of Bangladesh. *Journal of Environmental Management*, 02, Volume 231, pp. 419-428.
- Raleigh, C., Jordan, L. & Salehyan, I., 2009. Assessing the impact of climate change on the land hydrology in Taiwan.. *Paddy and Water Environment*.
- Ranasinghe, R., Callaghan, D. & Stive, M. J., 2012. Estimating coastal recession due to sea level rise: beyond the Bruun rule. *Climatic Change*, 110(3), pp. 561-574.

- Ranganathan, P., Pramesh, C. S. & Aggarwal, R., 2017. Common pitfalls in statistical analysis: Logistic regression. *Perspective in Clinical Research*, 8(3), pp. 148-151.
- Ratter, B., Philipp, K. & Von, S. H., 2012. Between Hype and Decline: Recent Trends in Public Perception of Climate Change. *Environmental Science and Policy*, Volume 18.
- Ravallion, M., 1996. Issues in measuring and modeling poverty. *The World Bank*.
- Ravallion, M., 1998. Expected Poverty Under Risk-Induced Welfare Variability. *Economic Journal*, pp. 1173-1183.
- Renn, O., 2010. The contribution of different types of knowledge towards understanding, sharing and communication risk concepts. *Catalan Journal of Communication & Cultural Studies*, 2(2), pp. 177-195.
- Retchless, D. P., 2018. Understanding Local Sea Level Rise Risk Perceptions and the Power of Maps to Change Them: The Effects of Distance and Doubt. *Environment and Behavior*, 01 06.50(5).
- Rignot, E. et al., 2011. *The Copenhagen Diagnosis, 2009: Updating the world on the Latest Climate Science*. s.l.:s.n.
- Roaf, S., Roaf, S., Crichton, D. & Nicol, F., 2005. *Adapting Buildings and Cities for Climate Change: A 21st Century Survival Guide*. s.l.:Routledge.
- Robert, S. & Schleyer-Lindenmann, A., 2021. How ready are we to cope with climate change? Extent of adaptation to sea level rise and coastal risks in local planning documents of southern France. *Land Use Policy*, 01 05.p. 105354.
- Roder, G., Hudson, P. & Tarolli, P., 2019. Flood risk perceptions and the willingness to pay for flood insurance in the Veneto region of Italy. *International Journal of Disaster Risk Reduction*, 01 07. Volume 37.
- Rolfe, J., Bennett, J. & Louviere, J., 2000. Choice modelling and its potential application to tropical rainforest preservation. *Ecological Economics*, 35(2), p. 289–302.
- Rolfe, J. & Bennett, J. W., 1996. *Valuing international rainforests: a choice modelling approach*, s.l.: s.n.
- Rolfe, J., Blamey, R. K. & Bennett, J., 1997. *Remnant vegetation and broadscale tree clearing in the Desert Uplands Region of Queensland*. s.l.:School of Economics and Management, University College, University of New
- Ruben, R., 2011. Can Religion contribute to Development? The road from ‘truth’ to ‘trust’. *Exchange*.
- Ryan, A. et al., 2011. *Perceptions of Sea-Level Rise Risk and the Assessment of Managed Retreat Policy: Results from an Exploratory Community Survey in Australia CSIRO*; s.l.: Climate Adaptation National Research Flagship.
- Saha, S., 2009. Climate Change, Livelihood and Human Rights: A Case Study.
- Sandman, P. M., 1987. Risk communication: facing public outrage. *EPA J.*, Volume 13, p. 21.
- Schinko, T. et al., 2020. Economy-wide effects of coastal flooding due to sea level rise: a multi-model simultaneous treatment of mitigation, adaptation, and residual impacts. *Environmental Research Communications*, 2(1).

- Schipper, E., 2007. Climate change adaptation and development: : Exploring the linkages.. *Tyndall Centre for Climate Change Research*, Volume 7.
- Schoubroeck, C., 1999. *Flood Insurance Systems in Selected European Countries*. s.l., s.n.
- Schuldt, J. & Roh, S., 2014. Media frames and cognitive accessibility: What do “global warming” and “climate change” evoke in partisan minds?. *Environmental Communication*, 8(4).
- Schultz, T. W., 1980. Noble Lecture: The Economics of being poor. *Journal of Political Economy*, 88(4), pp. 693-651.
- Senevirante, S. I. et al., 2012. Managing the risks of extreme events and disasters to advance climate change adaptation: Changes in climate extremes and their impacts on the natural physical environment.
- Serdeczny, O. et al., 2017. Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions. *Regional Environmental Change*, 17(6), p. 1585–1600.
- Shao, W., Moftakhari, H. & Moradkhani, H., 2020. Comparing public perceptions of sea level rise with scientific projections across five states of the U.S. Gulf Coast region. *Climatic Change*, Issue 1, p. 163.
- Shi, H. & Yin, G., 2018. Boosting conditional logit model. *Journal of choice modelling*, Volume 26, pp. 48-63.
- Short, A. D. & Woodroffe, C. D., 2009. *The Coast of Australia*. s.l.:Cambridge University Press.
- Siikamäki, J. & Layton, D. F., 2007. Discrete choice survey experiments: a comparison using flexible methods. *Journal of Environmental Economics and Management*, 53(1).
- Slaymaker, O., 1999. Natural hazards in British Columbia: an interdisciplinary and inter-institutional challenge. *International Journal of Earth Sciences*.
- Slovic, P., 1987. Perception of risk. 236(4799).
- Slovic, P., 1999. Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-Assessment Battlefield. *Risk Analysis*, 19(4).
- Smith, K. R., 2013. *The Global Greenhouse Regime: Who Pays?*. s.l.:Routledge.
- Solomon, S., Manning, m., Marquis, M. & Qin, D., 2007. *Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC*. s.l.:Cambridge University Press.
- Solomon, S., Manning, M., Marquis, M. & Qin, D., 2007. *Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC*. s.l.:Cambridge University Press.
- Sonnett, J., 2010. Climates of risk: A field analysis of global climate change in US media discourse, 1997-2004. *Public Understanding of Science*, 19(6).
- Spence, A. & Pidgeon, N., 2010. Framing and communicating climate change: The effects of distance and outcome frame manipulations. *Global Environmental Change*, 20(4).

- Spencer, T. et al., 2016. Global coastal wetland change under sea-level rise and related stresses: The DIVA Wetland Change Model. *Global and Planetary Change*.
- Steiger, R., Posch, E., Tappeiner, G. & Walde, J., 2020. The impact of climate change on demand of ski tourism - a simulation study based on stated preferences. *Ecological Economics*, Volume 170, p. 106589.
- Sterman, J. D., 2008. Risk communication on climate: mental models and mass balance. *Science*.
- Stern, N. H. et al., 2006. *Stern Review: The economics of climate change*. Cambridge: Cambridge University Press.
- Stiglitz, J. E., 2013. 7. Sharing the Burden of Saving the Planet: Global Social Justice for Sustainable Development. Lessons from the Theory of Public Finance. In: *The Quest for Security*. s.l.:Columbiana University Press, pp. 161-204.
- Stocker, T. et al., 2013. IPCC, 2013: summary for policymakers in climate change 2013: the physical science basis, contribution of working group I to the fifth assessment report of the intergovernmental panel on climate change. *Camb. Univ. Press Camb. UK NY NY USA*.
- Stojanov, R. et al., 2017. Local perceptions of climate change impacts and migration patterns in Malé, Maldives. *The Geographical Journal*, 183(4), pp. 370-385.
- Stone, C. D., 1992. Beyond Rio: "Insuring" Against Global Warming. *American Journal of International Law*, 86(3), pp. 445-448.
- Surminski, S. & Eldridge, J., 2017. Flood insurance in England – an assessment of the current and newly proposed insurance scheme in the context of rising flood risk. *Journal of Flood Risk Management*, 10(4), pp. 415-435.
- Suryahadi, A. & Sumarto, S., 2003. Poverty and vulnerability in Indonesia before and after the economic crisis. *Asian Economic Journal*.
- Suryahadi, A., Sumarto, S. & Pritchett, L., 2000. *Quantifying vulnerability to poverty: A proposed measure, applied to Indonesia*. s.l.:The World Bank.
- Swim, J. et al., 2011. Psychology's contributions to understanding and addressing global climate change. *American Psychologist*, 66(4), pp. 241-250.
- Taguiam, C. G. & Quiambo-Marquez, C. B., 2016. *Coastal households' perception of sea level rise in Quezon Province, Philippines*. s.l., s.n.
- Taherkhani, M. et al., 2020. Sea-level rise exponentially increases coastal flooding. *Scientific reports*, 10(1).
- Tandon, A. & Hasan, R., 2005. Conceptualizing and Measuring Poverty as Vulnerability: Does it make a difference?.
- Taylor, A. L., Dessai, S. & de Bruin, W. B., 2014. Public perception of climate risk and adaptation in the UK: A review of the literature. *Climate Risk Management*, Volume 4.

- Tesfaye, A. et al., 2019. Estimating the economic value of climate services for strengthening resilience of smallholder farmers to climate risks in Ethiopia: A choice experiment approach. *Ecological Economics*, Volume 162, pp. 157-168.
- Tesso, G., Emanu, B. & Ketema, M., 2012. Analysis of vulnerability and resilience to climate change induced shocks in North Shewa, Ethiopia. *Agricultural Sciences*, 15 10, 03(06), p. 871.
- Thomas, M. J., 2013. Public and expert perceptions of sea-level change on the Severn Estuary. *Environmental Science*.
- Thomas, M., Pigeon, N., Whitmarsh, L. & Ballinger, R., 2015. Mental models of sea-level change: A mixed methods analysis on the Severn Estuary, UK.. *Global Environmental Change*, Volume 33.
- Tietenberg, T. H. & Lewis, L., 2014. *Environmental and Natural Resource Economics*. 10 ed. s.l.:Routledge.
- Tigre, M. A., 2013. Insuring Island States: The Role of Insurance for Small Island States in Responding to the Adverse Effects of Sea Level Rise.
- Tol, R. S. J., 2009. The economic effects of climate change. *Journal of economic perspective*, 23(2), pp. 29-51.
- Tol, R. S. J., 2019. *CLIMATE ECONOMICS "Economic Analysis of Climate, Climate Change and Climate Policy"*. 2 ed. s.l.:Edward Elgar Pub.
- Train, J. & Cannings, T., 2013. Child poverty in an emergency and conflict context: a multidimensional profile and an identification of the poorest children in Western Darfur. *World Dev*, Volume 48, pp. 48-70.
- Train, K., 1999. Mixed logit models for recreation demands. *Valuing Recreation and the Environment'*, Edward Elgar, Northampton, MA.
- Train, K. E., 1998. Recreation demand models with taste diefferences over people. *Land economics*.
- Train, K. E., 2003. Discrete choice methods with simulation, Kenneth E. Train, Cambridge University Press, 2003, ISBN: 0-521-81696-3, pp. 334. *Journal of Applied Economics*, 18(3).
- Tyler, K., 2015. *Sea level rise adaptation primer: a toolkit to build adaptive capacity on Canada's Coasts. Presentation. Climate Action Secretariat, BC Ministry of Environment: Prince George*. s.l.:BC Ministry of Environment: Prince George.
- Uddin, M., Nasir, Bokelmann, W. & Dunn, E. S., 2017. Determinants of Farmers' Perception of Climate Change: A Case Study from the Coastal Region of Bangladesh. *American Journal of Climate Change*, 07 02, 6(1), pp. 151-165.
- Ukpong, I. G., 2019. ECONOMETRICS OF ENVIRONMENTAL VALUATION: THE BAYESIAN INFERENCES ON WILLINGNESS TO PAY ESTIMATIONS. *Review of Agricultural and Applied Economics (RAAE)*, 22(2), pp. 3-9.
- UNDESA, 2015. [Online]
Available at: <https://www.un.org/en/development/desa/news/2015.html>

UNEP, 2021. *UN Environment Programme*. [Online]

Available at: <http://www.unep.org/explore-topics/climate-action/what-we-do/climate-adaptation/ecosystem-based-adaptation>

UNFCCC, 2006. [Online]

Available at:

<https://www.bing.com/search?q=%28Climate+Change+Impacts%2C+Vulnerabilities+and+Adaptation+in+Developing+Countries%2C+2006+-+%28UNFCCC%29%29+&form=ANNH01&refig=a26b772492b04fcea0be454632d5c254&sp=-1&pq=%28climate+change+impacts%2C+vulnerabilities+and+adapt>

UNFCCC, 2015. *UNFCCC*. [Online]

Available at: <https://unfccc.int/topics/action-on-climate-and-sdgs/action-on-climate-and-sdgs>

United Nations, 2016. *Transforming Our World: The 2030 Agenda for Sustainable Development.*, New York: United Nation.

Van der Ploeg, F., 2018. The safe carbon budget. *Climatic Change*, 147(1), pp. 47-59.

Vecchi, G., 2007. *The concept of poverty: principles and practice*. s.l., s.n.

Victor, B. et al., 2013. Frustrated freedom: the effects of agency and wealth on wellbeing in rural Mozambique. *World Dev*, Volume 47, pp. 30-41.

WACA, 2018. [Online]

Available at: <https://documents1.worldbank.org/curated/en/541981527661149414/pdf/Fighting-coastal-erosion-in-Keta-area.pdf>

Waglé, U. R., 2008. Multidimensional poverty: An alternative measurement approach for the United States?. *Social Science research*.

Waltham, N. J. & Sheaves, M., 2015. Expanding coastal urban and industrial seascape in the Great Barrier Reef World Heritage Area: Critical need for coordinated planning and policy. *Marine Policy*, pp. 78-84.

Watkiss, P., 2011. [Online]

Available at:

[https://www.bing.com/search?q=Watkiss+P+\(ed\)+2011+The+ClimateCost+Project.+Final+Report.+1Eur+ope+\(Sweden%3A+Published+by+the+Stockholm+Environment+Institute\)+2011+ISBN+978-91-86125-35-6&qs=edge..69i57j69i60.9370j0j1&pglt=547&FORM=ANCMS9&PC=U531](https://www.bing.com/search?q=Watkiss+P+(ed)+2011+The+ClimateCost+Project.+Final+Report.+1Eur+ope+(Sweden%3A+Published+by+the+Stockholm+Environment+Institute)+2011+ISBN+978-91-86125-35-6&qs=edge..69i57j69i60.9370j0j1&pglt=547&FORM=ANCMS9&PC=U531)

[Accessed 07 04 2021-04-07].

Watson, R. T., Zinyower, M. C. & Moss, R. H., 1996. *Climate change 1995. Impacts, adaptations and mitigation of climate change: scientific-technical analyses*. s.l.:s.n.

Weber, E. U., 2006. Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change*, 77(1).

West, J. J., Small, M. J. & Dowlatabadi, H., 2001. Storms, Investor Decisions, and the Economic Impacts of Sea Level Rise. *Climatic Change*.

- Wilby, R. I. & Keenan, R., 2012. Adapting to flood risk under climate change. *Progress in Physical Geography: Earth and Environment*, 36(3), pp. 348-378.
- Wong, P. P. et al., 2014. Coastal Systems and low-lying areas. *Climate Change*, Volume 2104, pp. 361-409.
- World Bank, 2001. *World Development Report 2000/2001: Attacking Poverty*, s.l.: s.n.
- World Bank, 2010. [Online]
Available at: <https://www.worldbank.org/en/understanding-poverty>
- World Ocean Review, 2017. *Coping with rising sea levels*. [Online]
Available at: <https://worldoceanreview.com/en/wor-5/improving-coastal-protection/coping-with-rising-sea-levels/>
- Wouter Botzen, W. J. & Van Den Bergh, J. C. J. M., 2012. Monetary Valuation of Insurance Against Flood Risk Under Climate Change*. *International Economic Review*, 53(3), pp. 1005-1026.
- WRI, n.d. *World Resource Institute*. [Online]
Available at: <https://www.wri.org/climate>
- WSLR, 2019. *World Bank Data Catalog*. [Online]
Available at: <https://datacatalog.worldbank.org/search/dataset/0041449/World-Sea-Level-Rise-Dataset>
[Accessed 18 07 2022].
- Yohe, G., 1989. *The Cost of Not Holding Back the Sea: Phase 1 Economic Vulnerability*. s.l., s.n.
- Yohe, G., Neumann, J. & Ameden, H., 1995. Assessing the economic cost of greenhouse-induced sea level rise: methods and application in support of a national survey. *Journal of Environmental Economics and Management*, 29(3).
- Yohe, G., Neumann, j., Marshall, P. & Ameden, H., 1996. The economic cost of greenhouse-induced sea-level rise for developed property in the United States. *Climatic Change*, 32(4), pp. 387-410.
- Yohe, G. W. & Schlesinger, M. E., 1998. Sea-level change: the expected economic cost of protection or abandonment in the United States. *Climatic Change*, 38(4), pp. 447-472.
- Yoskowitz, D. W., Gibeaut, J. & McKenzie, A., 2009. The Socio-Economic Impact of Sea Level Rise in the Galveston Bay Region. p. 40.
- Yuksel, U. D., 2014. Analyzing vulnerability and resilience of Turkey to climate change. *Scientific Research and Essay Full*, 9(11), pp. 503-515.
- Zachariadis, T., 2016. Facts and projections on climate change. In: *Climate Change in Cyprus*. s.l.:Springer, pp. 5-24.
- Zhang, Y. & Wan, G., 2008. *Can we predict vulnerability to poverty?*, s.l.: s.n.

Appendix

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Figure 23. Figure 2.11. Average Marginal Effects of Choice with Respect to Attributes of the Insurance Packages for females **Error! Bookmark not defined.**



Figure 1. Impact of Recent Flood in Case Study Area

Source: Resident



Figure 2. Impact of Recent Flood in Case Study Area
Source: Resident



Figure 3. Impact of Recent Flood in Case Study Area
Source: Resident

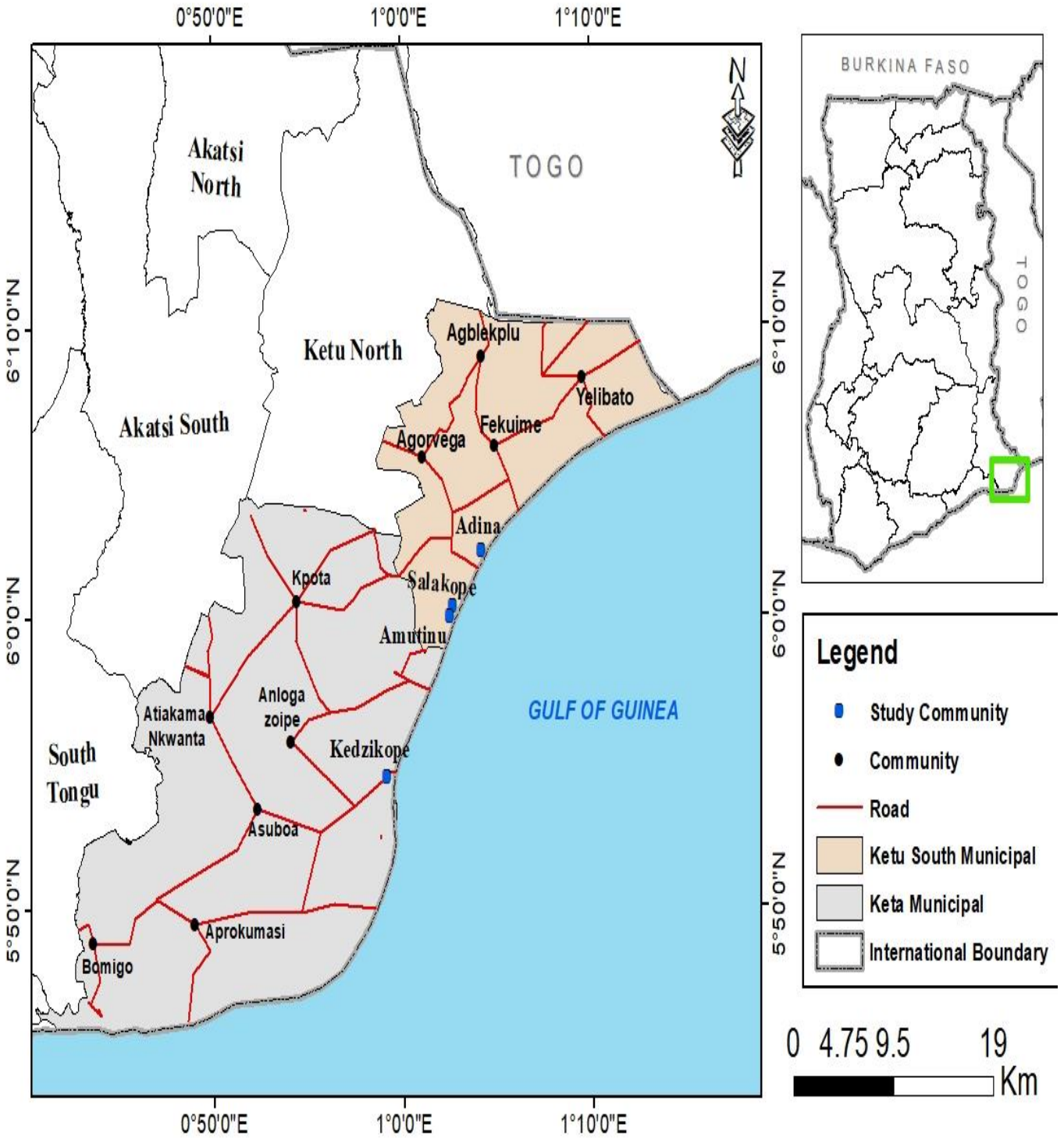


Figure 4. Map of Case study Area
 Source: Author's Generation with GIS

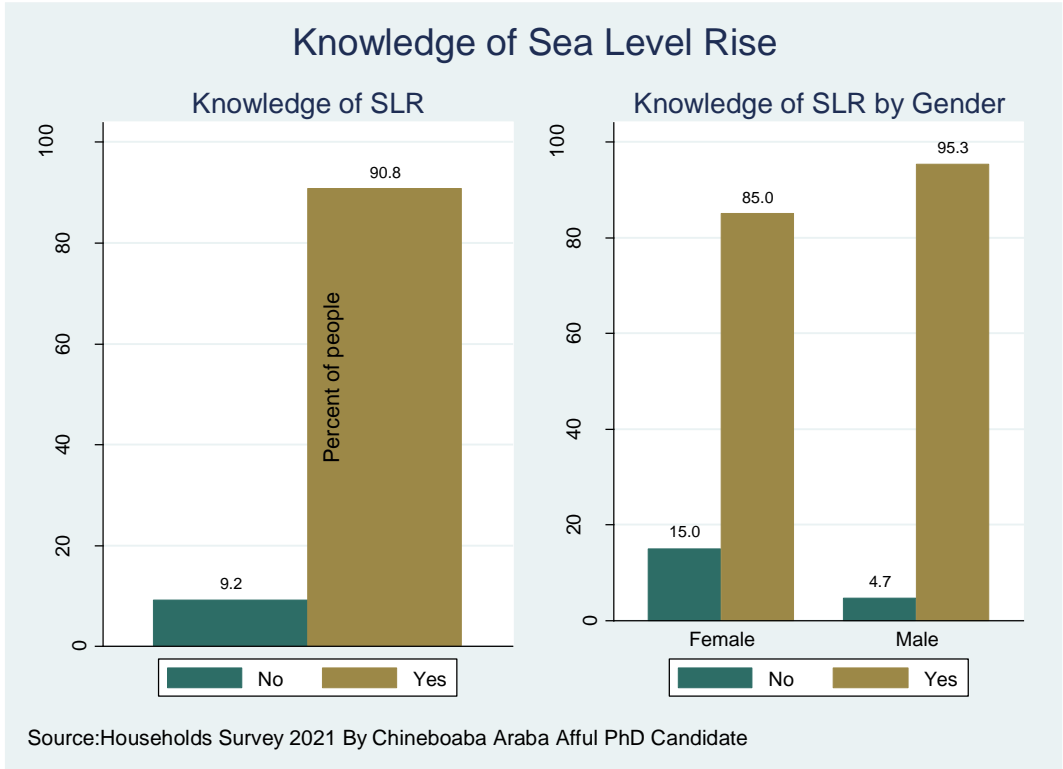


Figure 5. Knowledge of Sea Level Rise

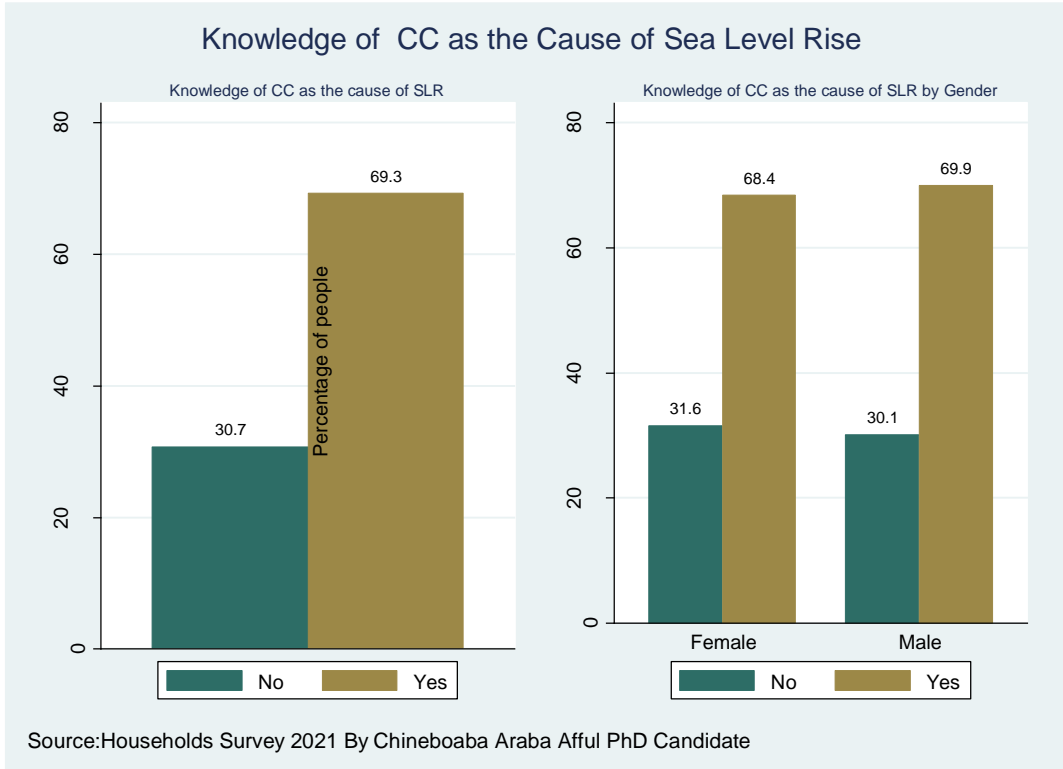


Figure 6. Knowledge of Climate as the Cause of Sea Level Rise

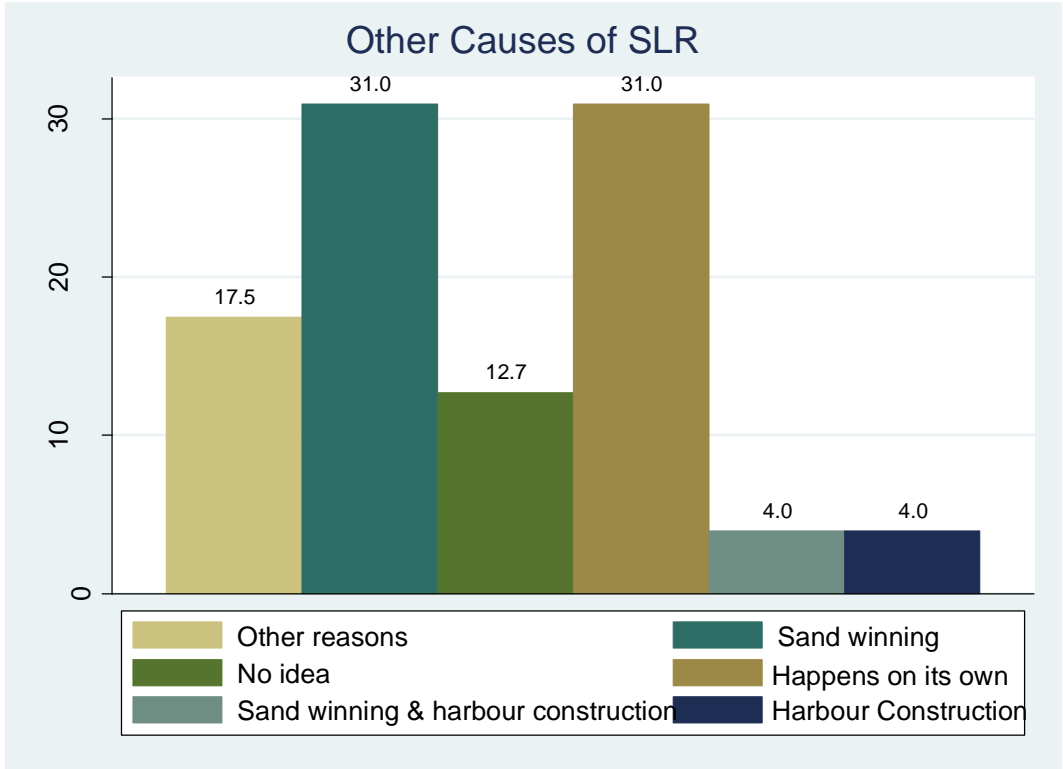


Figure 7. Causes of Sea Level from People do not think Climate Change is the Cause

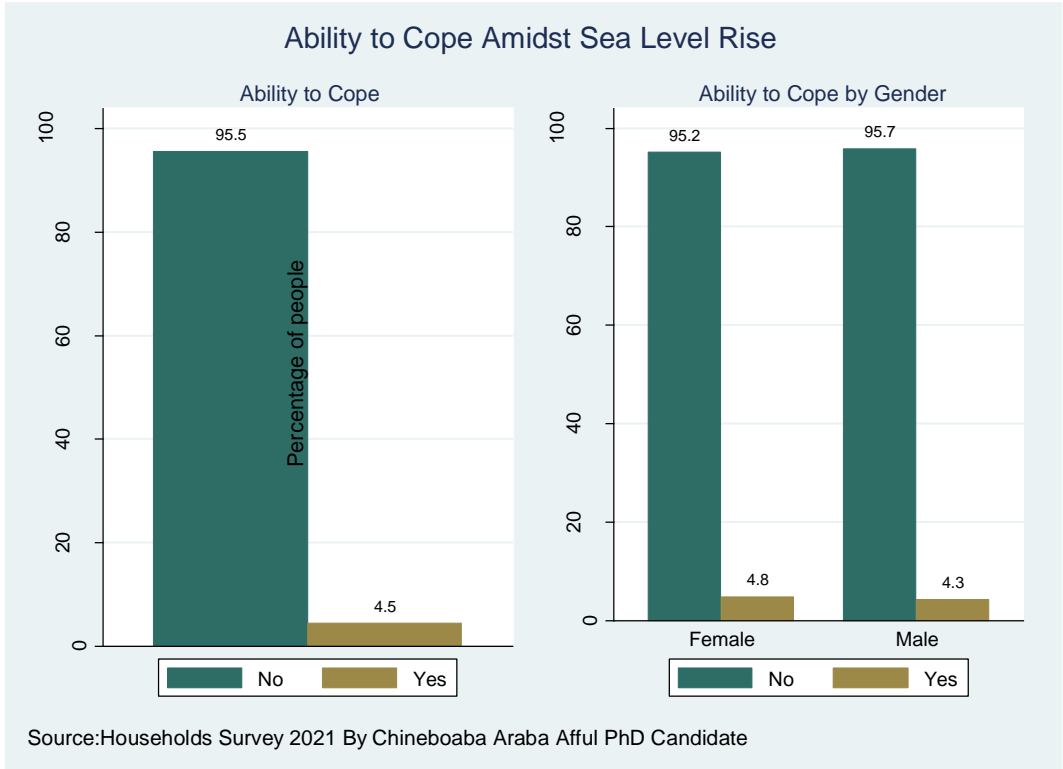


Figure 8. Ability to Cope

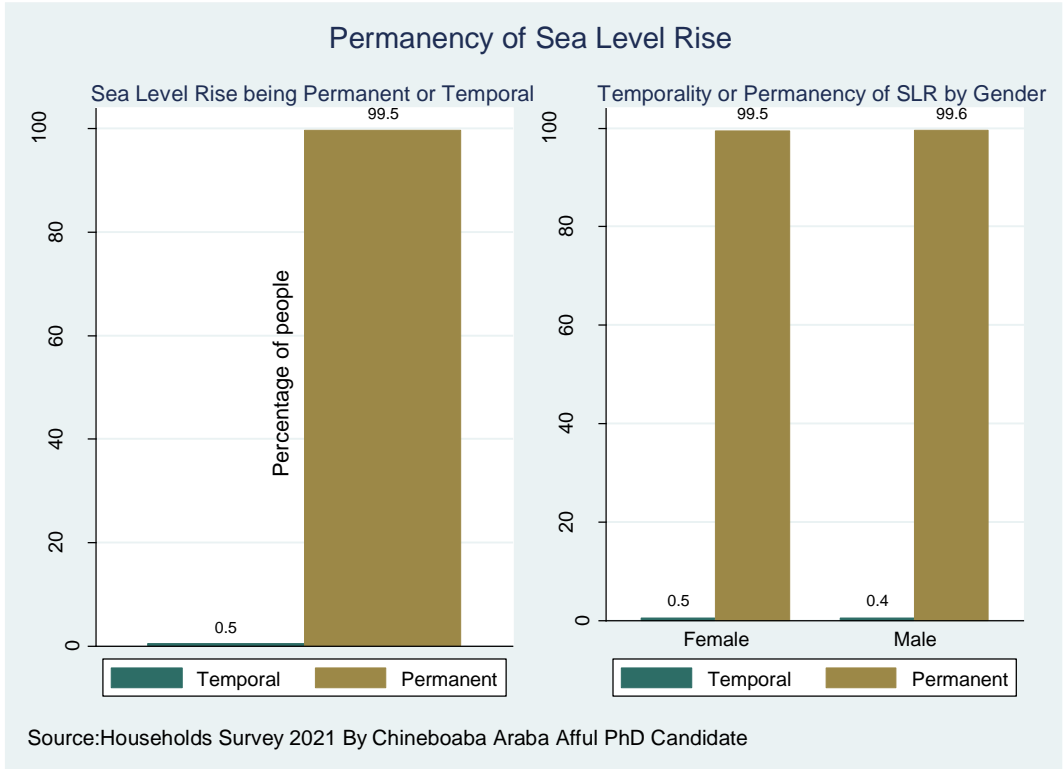


Figure 9. Permanency of Sea Level Rise

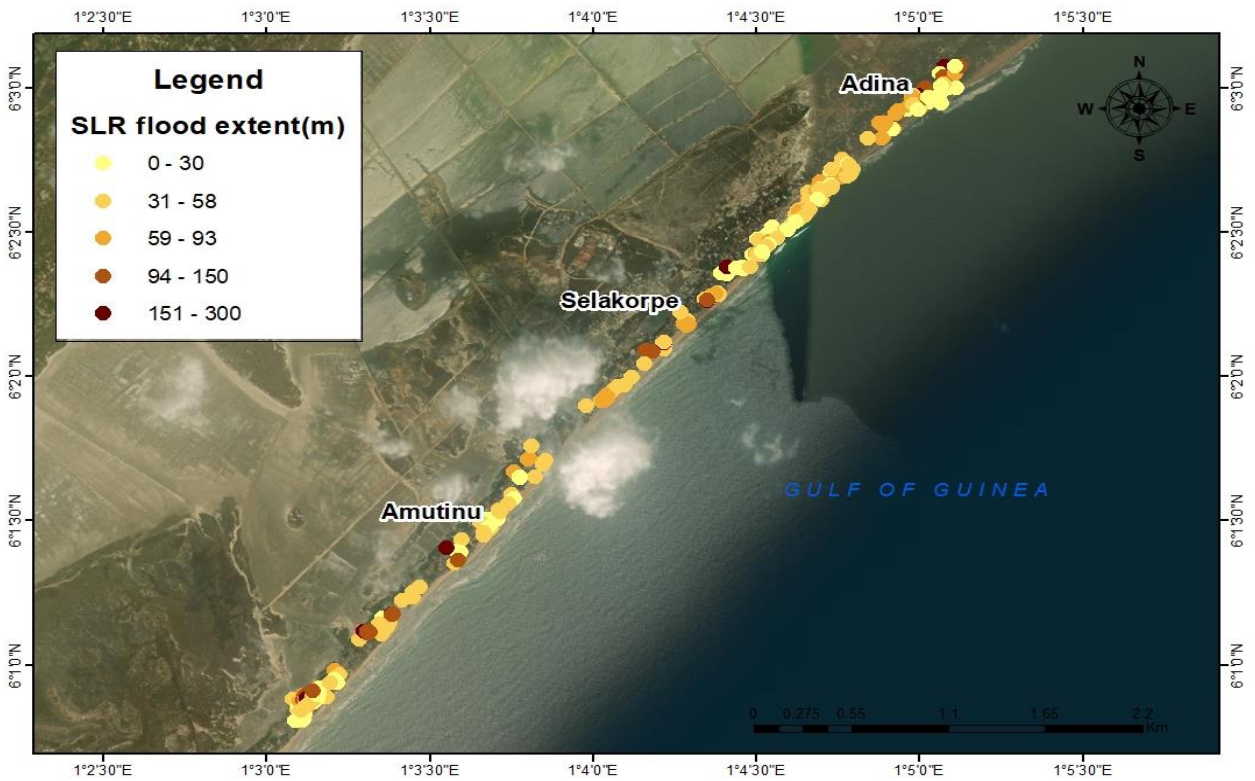


Figure 10. Extent of Flood in Ketu South Municipal

Source: Author's Generation from GIS



Figure 11. Extent of Flood in Keta Municipal
 Source: Author's Generation from GIS

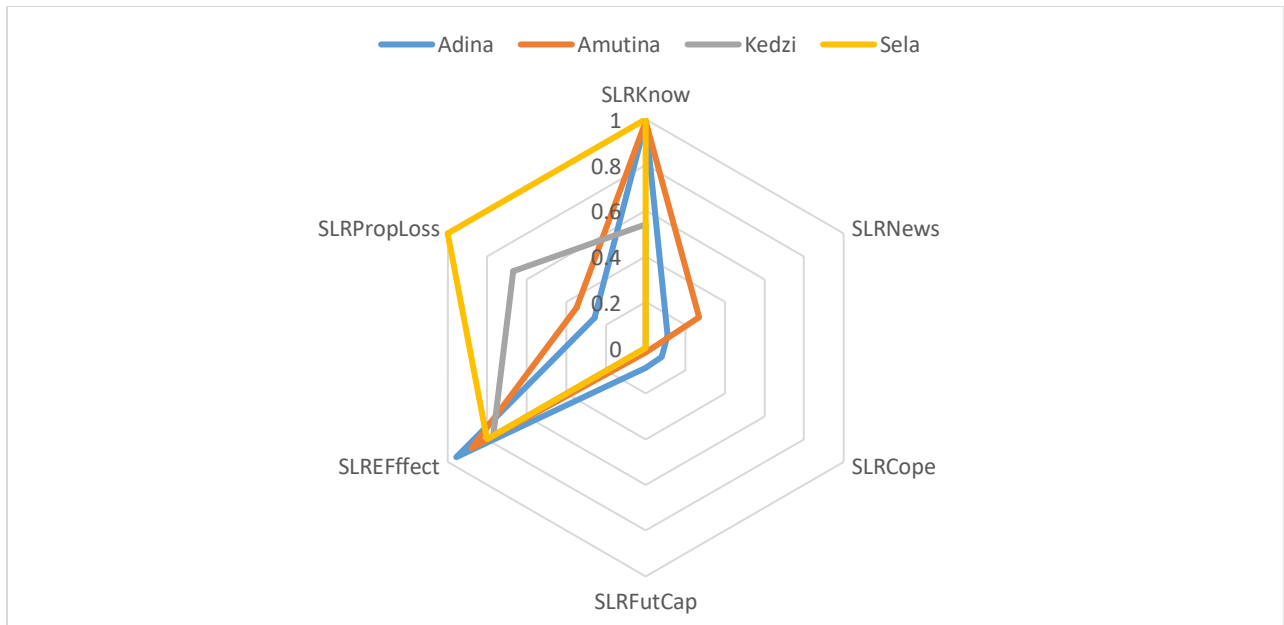


Figure 12. Conjoint Analysis
 Source: Author's Generation with Excel

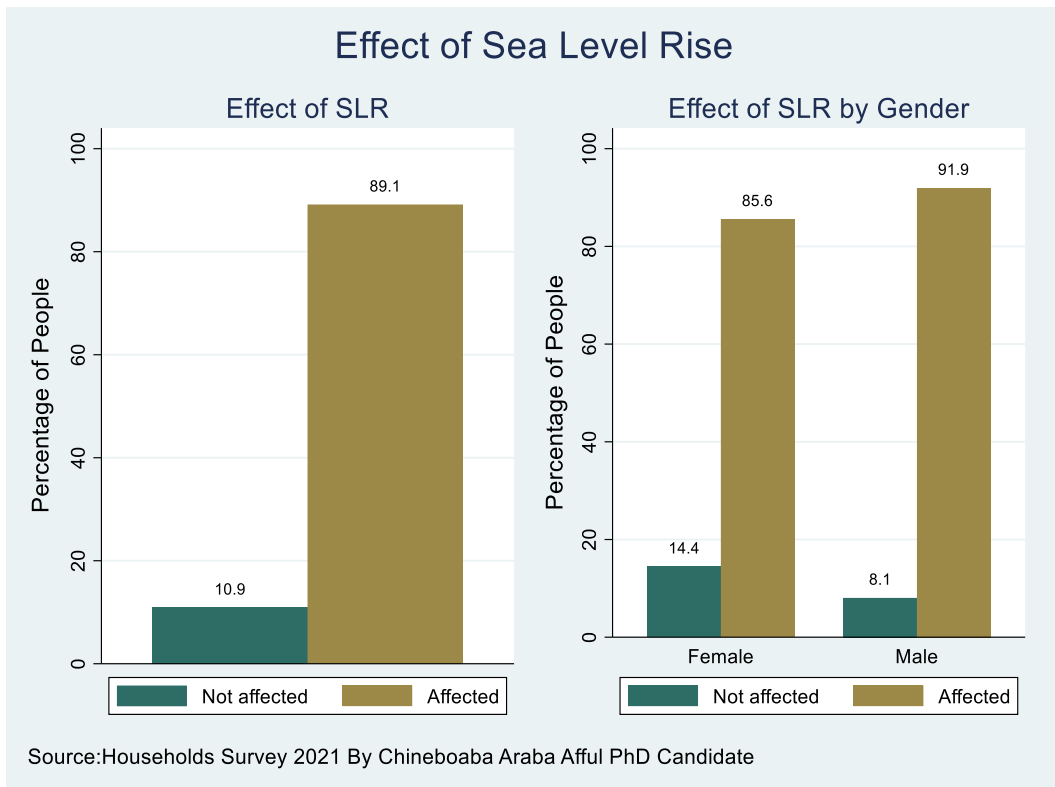


Figure 13. Effects of Sea Level Rise

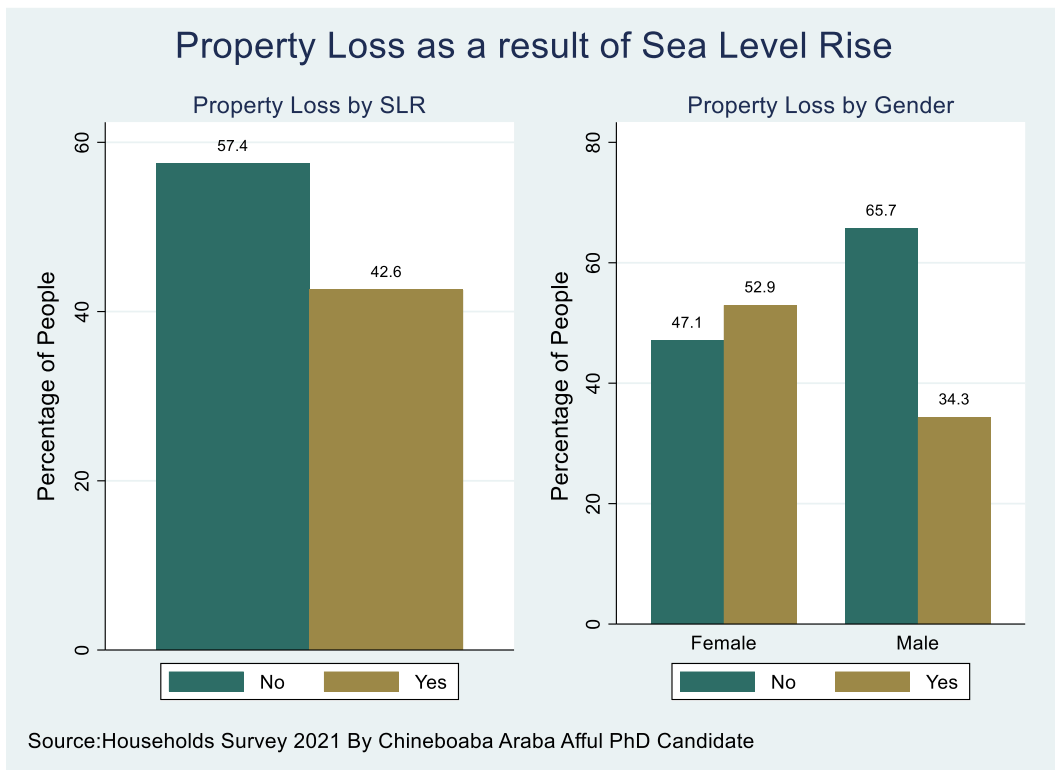
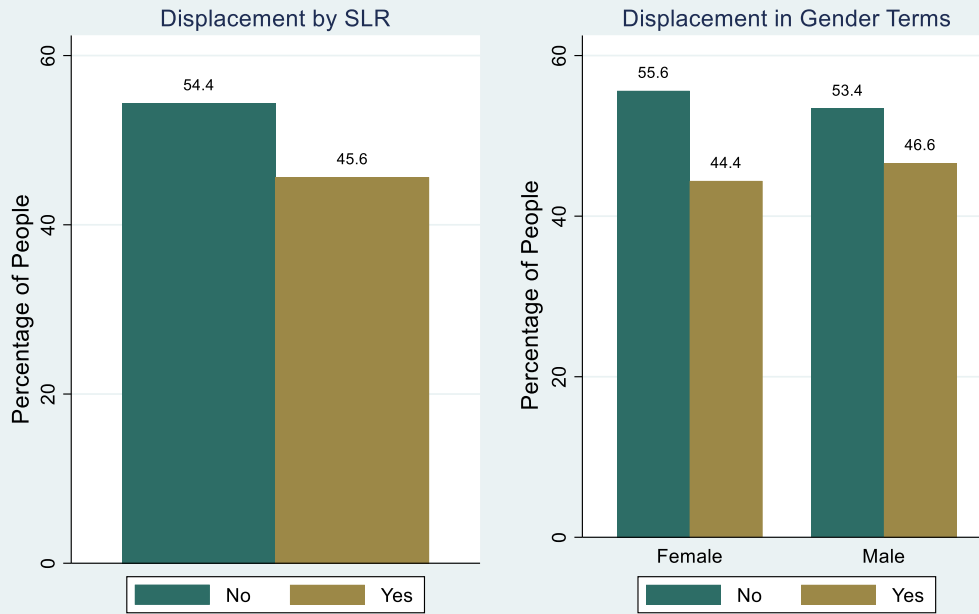


Figure 14. Property Loss as a Result of Sea Level Rise

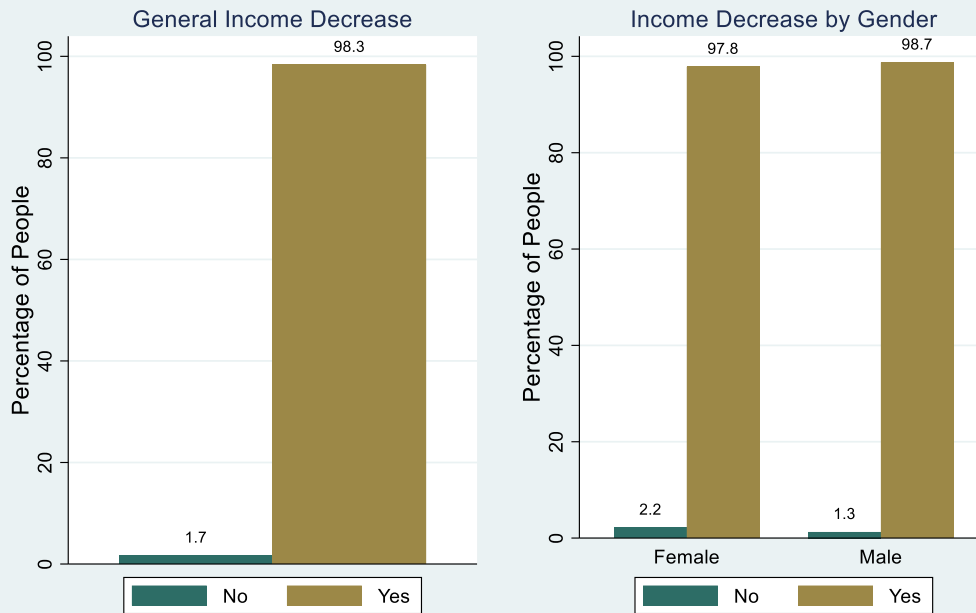
Displacement as a result of Sea Level Rise



Source:Households Survey 2021 By Chineboaba Araba Afful PhD Candidate

Figure 15. Displacement of Households as a Result of Sea Level Rise

Decrease in Income as a result of Sea Level Rise



Source:Households Survey 2021 By Chineboaba Araba Afful PhD Candidate

Figure 16. Decrease in Income as a Result of Sea Level Rise

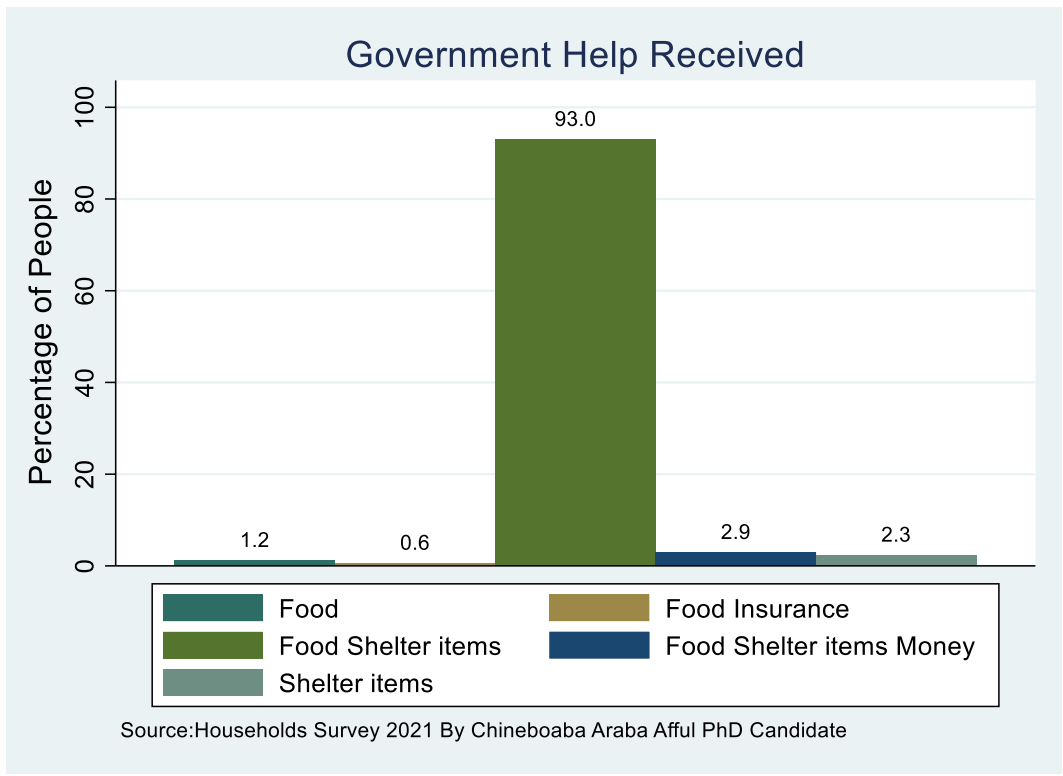


Figure 17. Government Support Received by Respondents

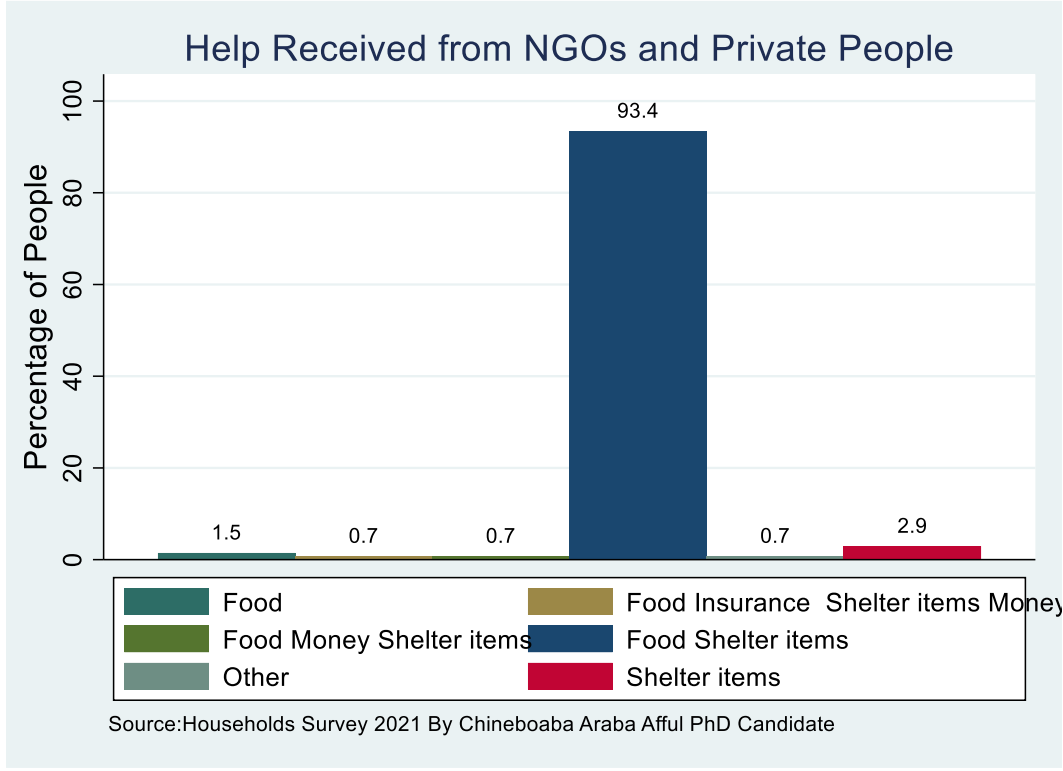


Figure 18. NGOs and Private Persons' Support received by Respondents

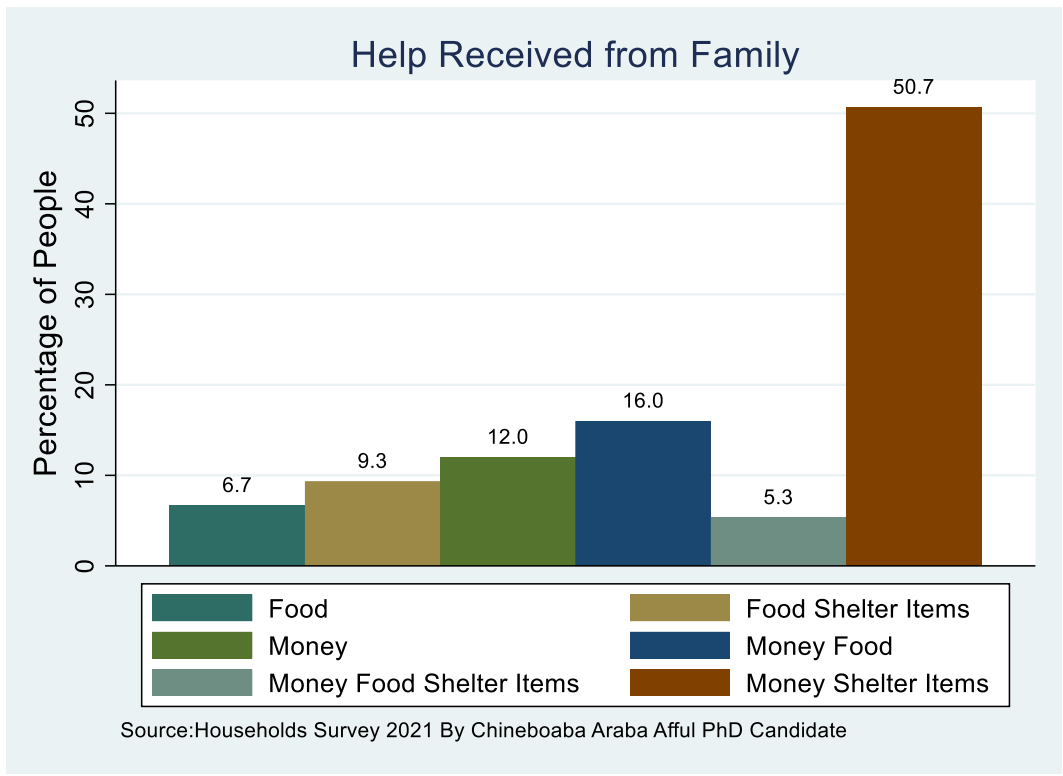


Figure 19. Family Support Received by Respondents

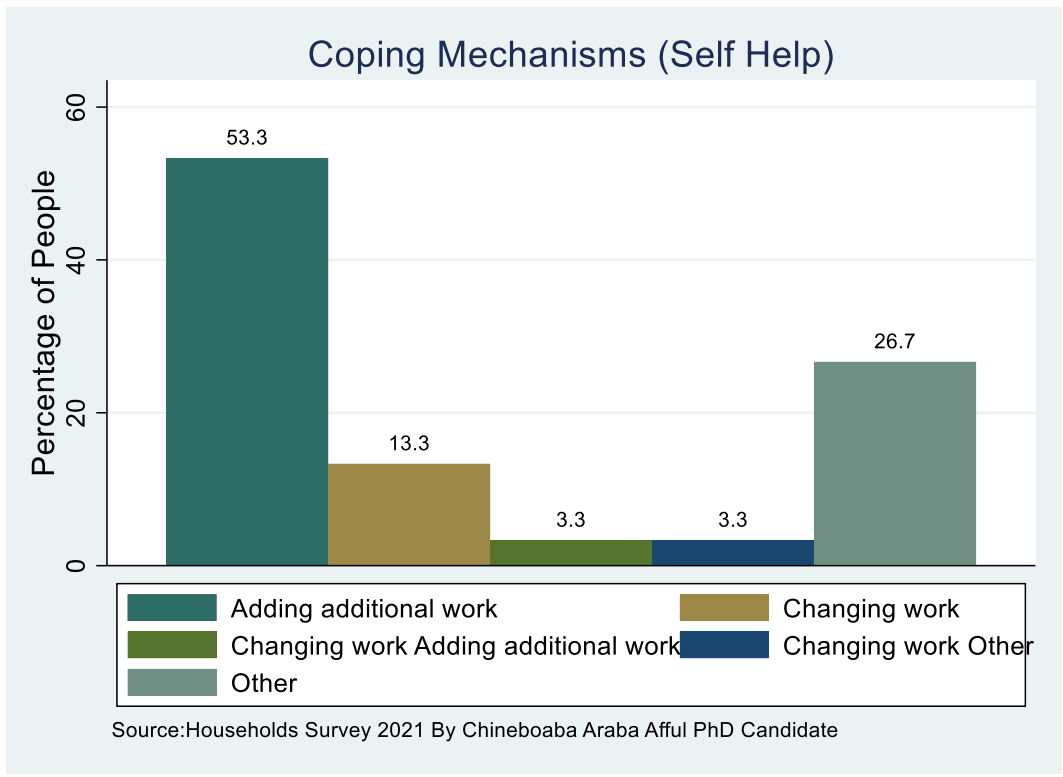


Figure 20. Coping Mechanisms Employed by Respondents.

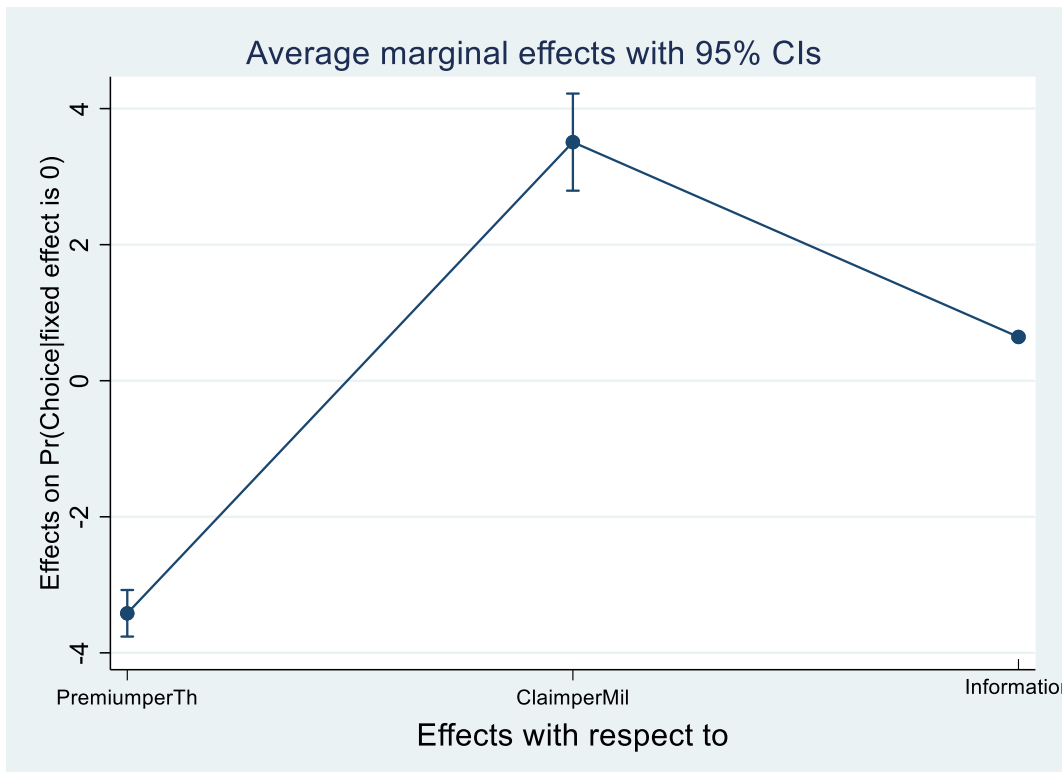


Figure 21. Average Marginal Effects of Choice with Respect to Attributes of the Insurance Packages for all respondents

Source: Author's Generation with Stata

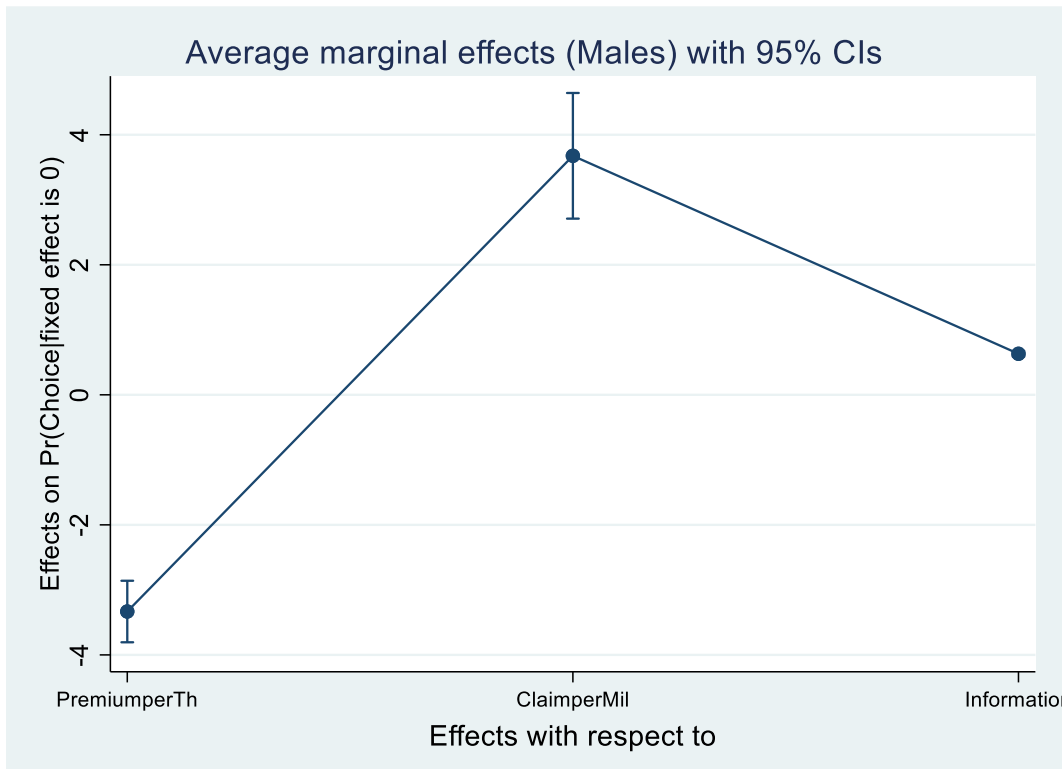


Figure 22. Average Marginal Effects of Choice with Respect to Attributes of the Insurance Packages for males

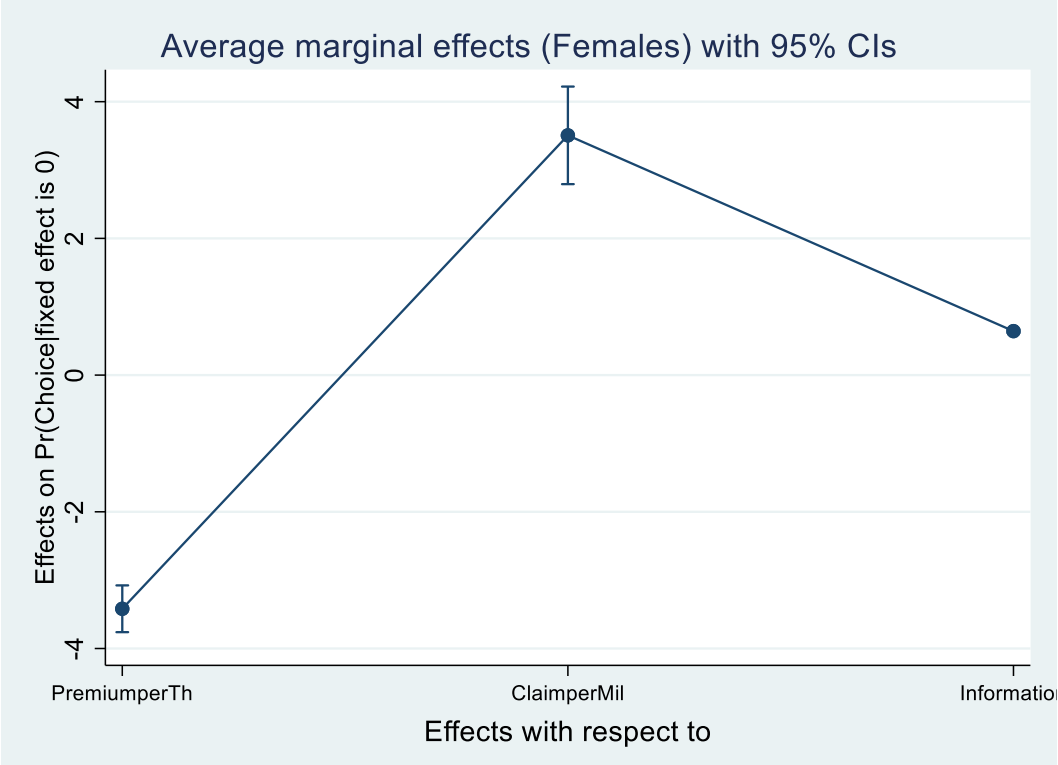


Figure 23. Figure 2.11. Average Marginal Effects of Choice with Respect to Attributes of the Insurance Packages for females

Excerpts from Essay 1

SLRKnow							
GenderD	.1737686	.2802271	0.62	0.535	-.3754665	.7230037	
Age	-.0153739	.0097437	-1.58	0.115	-.0344713	.0037234	
Edu2	.1874843	.2554983	0.73	0.463	-.3132831	.6882518	
NewMaritals~s	-.1030595	.2753213	-0.37	0.708	-.6426793	.4365604	
workdays	.3447558	.1315629	2.62	0.009	.0868973	.6026144	
workhours	-.0255887	.0452149	-0.57	0.571	-.1142083	.0630309	
HHnum	.1223818	.0524484	2.33	0.020	.0195849	.2251787	
Fishingacti~s	.0543583	.3310624	0.16	0.870	-.5945122	.7032287	
Saltmininga~s	-.2723182	.4300137	-0.63	0.527	-1.11513	.5704932	
SLRCope	-.6073871	.541676	-1.12	0.262	-1.669053	.4542784	
SLREfffect	.5874868	.365264	1.61	0.108	-.1284175	1.303391	
SLRPropLoss	-.0038119	.3095391	-0.01	0.990	-.6104974	.6028736	
SLRDisplace	.851103	.4802628	1.77	0.076	-.0901948	1.792401	
Income1	.6878287	.3946552	1.74	0.081	-.0856813	1.461339	
Income2	.266273	.333732	0.80	0.425	-.3878297	.9203758	
KedzikopeTown	-2.491513	.6710614	-3.71	0.000	-3.80677	-1.176257	
AmutinuTown	-.0468521	.4227688	-0.11	0.912	-.8754637	.7817596	
SelakorpeTown	2.968542	.7237127	4.10	0.000	1.550091	4.386992	
GPSLongs	-2.181326	5.360793	-0.41	0.684	-12.68829	8.325635	
_cons	1.963827	5.815719	0.34	0.736	-9.434773	13.36243	
/atanrho	-.0342079	.6578862	-0.05	0.959	-1.323641	1.255225	
rho	-.0341945	.6571169			-.8676866	.8497424	
Wald test of rho=0: chi2(1) = .002704					Prob > chi2 = 0.9585		

. vif

Variable	VIF	1/VIF
KedzikopeT~n	4.30	0.232427
GPSLongs	3.03	0.330320
Income1	2.17	0.461206
Income2	1.95	0.512848
SelakorpeT~n	1.73	0.579423
SLRKnow	1.64	0.608299
SLRPropLoss	1.59	0.628471
SLRDisplace	1.46	0.684602
AmutinuTown	1.43	0.696946
GenderD	1.38	0.727110
Saltmining~s	1.33	0.752719
Fishingact~s	1.31	0.760797
Age	1.26	0.793862
HHnum	1.21	0.824217
Edu2	1.18	0.848452
NewMarital~s	1.17	0.855868
SLRCope	1.13	0.885628
workdays	1.12	0.893692
SLREFfect	1.07	0.932990
Mean VIF	1.66	

Excerpts from Essay 2

Iteration 0: log likelihood = -1191.3832
 Iteration 1: log likelihood = -1169.1883
 Iteration 2: log likelihood = -1166.5697
 Iteration 3: log likelihood = -1166.5684
 Iteration 4: log likelihood = -1166.5684

Conditional (fixed-effects) logistic regression Number of obs = 4,845
 LR chi2(17) = 1215.38
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.3425
 Log likelihood = -1166.5684

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
PremiumpTh	-22.2936	2.182266	-10.22	0.000	-26.57076	-18.01644
ClaimperMil	20.48217	2.100181	9.75	0.000	16.36589	24.59844
Information	3.547313	.1429112	24.82	0.000	3.267212	3.827414
GenderPremTh	1.194884	.4165702	2.87	0.004	.3784216	2.011347
EduPremTh	.4415167	.3873801	1.14	0.254	-.3177343	1.200768
FishnPremTh	1.061167	.7498756	1.42	0.157	-.4085624	2.530896
SaltMinPremTh	.3249317	.6406967	0.51	0.612	-.9308107	1.580674
OtherPremTh	-.0264919	.6924453	-0.04	0.969	-1.38366	1.330676
SLRKnowPremTh	2.427302	.8002021	3.03	0.002	.8589346	3.995669
SLRCopePremTh	6.08818	1.180434	5.16	0.000	3.774571	8.401788
SLREffectsPremTh	.1165057	.6243602	0.19	0.852	-1.107218	1.340229
SLRPrLossPremTh	-.4224918	.4602721	-0.92	0.359	-1.324609	.4796249
SLRDisplacePremTh	1.116074	.4230763	2.64	0.008	.2868595	1.945288
INCDcrPremTh	-1.750382	1.508433	-1.16	0.246	-4.706857	1.206092
GovHpPremTh	-.3532507	.5487861	-0.64	0.520	-1.428852	.7223502
NGOPrHpPremTh	.3538969	.5967513	0.59	0.553	-.8157141	1.523508
FamHpPremTh	-.5938265	.5369499	-1.11	0.269	-1.646229	.458576

Iteration 0: log likelihood = -1300.8277
 Iteration 1: log likelihood = -1279.377
 Iteration 2: log likelihood = -1277.6915
 Iteration 3: log likelihood = -1277.6886
 Iteration 4: log likelihood = -1277.6886

Conditional (fixed-effects) logistic regression Number of obs = 5,073
 LR chi2(3) = 1160.13
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.3122
 Log likelihood = -1277.6886

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
PremiumpTh	-18.46908	1.06498	-17.34	0.000	-20.5564	-16.38175
ClaimperMil	18.94697	1.991376	9.51	0.000	15.04394	22.84999
Information	3.47549	.1366555	25.43	0.000	3.20765	3.74333

_n1_1: (_b[ClaimperMil])/- (_b[PremiumpTh])

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
_n1_1	1.025875	.0578731	17.73	0.000	.912446	1.139304

Iteration 0: log likelihood = -707.75242
 Iteration 1: log likelihood = -685.5578
 Iteration 2: log likelihood = -683.70733
 Iteration 3: log likelihood = -683.70605
 Iteration 4: log likelihood = -683.70605

Conditional (fixed-effects) logistic regression

Number of obs = 2,745
 LR chi2(16) = 643.05
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.3199

Log likelihood = -683.70605

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
PremiumpTh	-19.43584	3.381061	-5.75	0.000	-26.0626	-12.80908
ClaimperMil	19.76274	2.692551	7.34	0.000	14.48543	25.04004
Information	3.379179	.1812992	18.64	0.000	3.02384	3.734519
EduPremTh	.0084073	.5213787	0.02	0.987	-1.013476	1.030291
FishnPremTh	1.741828	1.310202	1.33	0.184	-.8261199	4.309777
SaltMinPremTh	4.52582	1.541784	2.94	0.003	1.503979	7.547662
OtherPremTh	1.740306	1.008173	1.73	0.084	-.2356761	3.716288
SLRKnowPremTh	-.0073075	1.256172	-0.01	0.995	-2.469359	2.454744
SLRCopePremTh	7.572932	2.261366	3.35	0.001	3.140737	12.00513
SLREffectsPremTh	-.2061397	.8910317	-0.23	0.817	-1.95253	1.54025
SLRPrLossPremTh	-.2670576	.6223104	-0.43	0.668	-1.486764	.9526484
SLRDisplacePremTh	.6884974	.5496099	1.25	0.210	-.3887183	1.765713
INCDcrPremTh	-.7103395	2.432466	-0.29	0.770	-5.477885	4.057207
GovHpPremTh	1.082567	.7749403	1.40	0.162	-.4362885	2.601422
NGOPrHpPremTh	-1.533575	.8698759	-1.76	0.078	-3.2385	.1713503
FamHpPremTh	-.2717787	.7909137	-0.34	0.731	-1.821941	1.278384

```

Iteration 0: log likelihood = -752.90845
Iteration 1: log likelihood = -732.57651
Iteration 2: log likelihood = -731.39727
Iteration 3: log likelihood = -731.39483
Iteration 4: log likelihood = -731.39483

```

Conditional (fixed-effects) logistic regression

```

Number of obs = 2,805
LR chi2(3) = 591.62
Prob > chi2 = 0.0000
Pseudo R2 = 0.2880

```

Log likelihood = -731.39483

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
PremiumperTh	-17.17853	1.392304	-12.34	0.000	-19.90739	-14.44966
ClaimperMil	18.94891	2.581508	7.34	0.000	13.88925	24.00858
Information	3.253339	.1726893	18.84	0.000	2.914874	3.591804

```
. nlcom (_b[ClaimperMil])/- (_b[PremiumperTh])
```

```

      _nl_1: (_b[ClaimperMil])/- (_b[PremiumperTh])

```

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
_nl_1	1.103058	.0744867	14.81	0.000	.9570666	1.249049

Iteration 0: log likelihood = -470.79552
 Iteration 1: log likelihood = -465.33567
 Iteration 2: log likelihood = -464.19765
 Iteration 3: log likelihood = -464.19757
 Iteration 4: log likelihood = -464.19757

Conditional (fixed-effects) logistic regression

Number of obs = 2,100
 LR chi2(16) = 609.66
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.3964

Log likelihood = -464.19757

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
PremiuperTh	-23.53526	3.103917	-7.58	0.000	-29.61883	-17.4517
ClaimperMil	22.40937	3.443505	6.51	0.000	15.66022	29.15851
Information	3.845737	.2366338	16.25	0.000	3.381943	4.309531
EduPremTh	.7902615	.6201404	1.27	0.203	-.4251914	2.005714
FishnPremTh	.2605832	1.003815	0.26	0.795	-1.706858	2.228024
SaltMinPremTh	-1.089884	.7800177	-1.40	0.162	-2.618691	.4389221
OtherPremTh	-1.758362	1.040749	-1.69	0.091	-3.798192	.2814682
SLRKnowPremTh	3.999092	1.153803	3.47	0.001	1.73768	6.260504
SLRCopePremTh	5.639608	1.531451	3.68	0.000	2.638019	8.641197
SLREffectsPremTh	.4647363	.8977284	0.52	0.605	-1.294779	2.224252
SLRPrLossPremTh	-.7720481	.7348637	-1.05	0.293	-2.212355	.6682583
SLRDisplacePremTh	1.687777	.7208138	2.34	0.019	.2750081	3.100546
INCDcrPremTh	-2.744528	2.011119	-1.36	0.172	-6.686249	1.197193
GovHpPremTh	-1.616537	.867534	-1.86	0.062	-3.316873	.0837981
NGOPrHpPremTh	1.533565	.8977117	1.71	0.088	-.2259178	3.293047
FamHpPremTh	-.6100265	.7724083	-0.79	0.430	-2.123919	.9038659

Iteration 0: log likelihood = -539.98193
 Iteration 1: log likelihood = -535.58878
 Iteration 2: log likelihood = -535.05616
 Iteration 3: log likelihood = -535.05543
 Iteration 4: log likelihood = -535.05543

Conditional (fixed-effects) logistic regression

Number of obs = 2,268
 LR chi2(3) = 590.99
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.3558

Log likelihood = -535.05543

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
PremiuperTh	-20.30172	1.673632	-12.13	0.000	-23.58198	-17.02146
ClaimperMil	18.80692	3.180007	5.91	0.000	12.57422	25.03962
Information	3.843882	.2285383	16.82	0.000	3.395956	4.291809

_nl_1: (_b[ClaimperMil])/- (_b[PremiuperTh])

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
_nl_1	.9263706	.0931238	9.95	0.000	.7438513	1.10889

. nlcom (_b[ClaimperMil])/- (_b[PremiuperTh])

_nl_1: (_b[ClaimperMil])/- (_b[PremiuperTh])

Choice	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
_nl_1	.9263706	.0931238	9.95	0.000	.7438513	1.10889

Excerpts from Essay 3

. reg LogIncomeperHH GenderD Age Edu2 NewMaritalStatus i.Townn Saltminingactivities Fishingactivit
> ies OtherLivelih SaltWorkHrs FishnWorkHrs OtherActHrs SLRPropLoss SLRDisplace SLREfffect

Source	SS	df	MS	Number of obs	=	415
Model	50.4500628	16	3.15312893	F(16, 398)	=	7.67
Residual	163.597049	398	.411047862	Prob > F	=	0.0000
				R-squared	=	0.2357
				Adj R-squared	=	0.2050
Total	214.047112	414	.51702201	Root MSE	=	.64113

LogIncomeperHH	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
GenderD	.0490194	.073597	0.67	0.506	-.0956681	.1937069
Age	-.0117027	.0026597	-4.40	0.000	-.0169315	-.0064739
Edu2	.0013287	.0696261	0.02	0.985	-.1355523	.1382096
NewMaritalStatus	-.1374855	.07064	-1.95	0.052	-.2763598	.0013887
Townn						
1	-.44602	.1032787	-4.32	0.000	-.6490599	-.24298
2	-.8330549	.1392309	-5.98	0.000	-1.106775	-.5593349
3	-.439473	.1140039	-3.85	0.000	-.663598	-.215348
Saltminingactivities	-.3972958	.3771474	-1.05	0.293	-1.138746	.3441542
Fishingactivities	.507612	.2014082	2.52	0.012	.111655	.903569
OtherLivelih	-.101475	.2631388	-0.39	0.700	-.6187907	.4158407
SaltWorkHrs	.0338578	.0328742	1.03	0.304	-.0307709	.0984865
FishnWorkHrs	-.0305519	.0148235	-2.06	0.040	-.059694	-.0014098
OtherActHrs	.0271548	.0226032	1.20	0.230	-.0172818	.0715914
SLRPropLoss	-.167014	.0787691	-2.12	0.035	-.3218696	-.0121585
SLRDisplace	-.1612405	.0741867	-2.17	0.030	-.3070873	-.0153938
SLREfffect	-.0097777	.1068296	-0.09	0.927	-.2197984	.2002431
_cons	7.724136	.2140034	36.09	0.000	7.303418	8.144855

. estat hettest B

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
 Assumption: Normal error terms
 Variable: B

H0: Constant variance

chi2(1) = 23.18
 Prob > chi2 = 0.0000

. reg lresv2 GenderD Age Edu2 NewMaritalStatus i.Townn Saltminingactivities Fishingactivities Othe
 > rLivelih SaltWorkHrs FishnWorkHrs OtherActHrs SLRPropLoss SLRDisplace SLREfffect

Source	SS	df	MS	Number of obs	=	415
Model	189.275669	16	11.8297293	F(16, 398)	=	2.51
Residual	1874.14774	398	4.70891391	Prob > F	=	0.0011
				R-squared	=	0.0917
				Adj R-squared	=	0.0552
Total	2063.42341	414	4.98411451	Root MSE	=	2.17

	lresv2	Coefficient	Std. err.	t	P> t	[95% conf. interval]
	GenderD	.0479001	.2491003	0.19	0.848	-.4418168 .537617
	Age	-.0060305	.0090021	-0.67	0.503	-.023728 .0116671
	Edu2	.0746622	.2356603	0.32	0.752	-.3886323 .5379567
	NewMaritalStatus	.0262999	.239092	0.11	0.912	-.4437412 .496341
	Townn					
	1	.7106089	.3495626	2.03	0.043	.0233891 1.397829
	2	.483157	.4712485	1.03	0.306	-.4432903 1.409604
	3	1.34685	.3858635	3.49	0.001	.588265 2.105436
	Saltminingactivities	.3588022	1.276513	0.28	0.779	-2.150749 2.868353
	Fishingactivities	.1227875	.6816971	0.18	0.857	-1.21739 1.462965
	OtherLivelih	.9007894	.8906336	1.01	0.312	-.8501449 2.651724
	SaltWorkHrs	.0377398	.1112676	0.34	0.735	-.1810059 .2564855
	FishnWorkHrs	-.0111743	.0501724	-0.22	0.824	-.1098104 .0874617
	OtherActHrs	-.0838878	.076504	-1.10	0.274	-.2342903 .0665146
	SLRPropLoss	.980733	.2666062	3.68	0.000	.4566006 1.504865
	SLRDisplace	-.1430917	.2510962	-0.57	0.569	-.6367324 .3505489
	SLREfffect	.5840033	.361581	1.62	0.107	-.1268441 1.294851
	_cons	-3.652566	.7243272	-5.04	0.000	-5.076552 -2.22858

```
. reg LogIncomeperHH GenderD Age Edu2 NewMaritalStatus i.Townn Saltminingactivities Fishingactivit
> ies OtherLivelih SaltWorkHrs FishnWorkHrs OtherActHrs SLRPropLoss SLRDisplace SLREfffect
```

Source	SS	df	MS	Number of obs	=	415
Model	50.4500628	16	3.15312893	F(16, 398)	=	7.67
Residual	163.597049	398	.411047862	Prob > F	=	0.0000
				R-squared	=	0.2357
				Adj R-squared	=	0.2050
Total	214.047112	414	.51702201	Root MSE	=	.64113

LogIncomeperHH	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
GenderD	.0490194	.073597	0.67	0.506	-.0956681	.1937069
Age	-.0117027	.0026597	-4.40	0.000	-.0169315	-.0064739
Edu2	.0013287	.0696261	0.02	0.985	-.1355523	.1382096
NewMaritalStatus	-.1374855	.07064	-1.95	0.052	-.2763598	.0013887
Townn						
1	-.44602	.1032787	-4.32	0.000	-.6490599	-.24298
2	-.8330549	.1392309	-5.98	0.000	-1.106775	-.5593349
3	-.439473	.1140039	-3.85	0.000	-.663598	-.215348
Saltminingactivities	-.3972958	.3771474	-1.05	0.293	-1.138746	.3441542
Fishingactivities	.507612	.2014082	2.52	0.012	.111655	.903569
OtherLivelih	-.101475	.2631388	-0.39	0.700	-.6187907	.4158407
SaltWorkHrs	.0338578	.0328742	1.03	0.304	-.0307709	.0984865
FishnWorkHrs	-.0305519	.0148235	-2.06	0.040	-.059694	-.0014098
OtherActHrs	.0271548	.0226032	1.20	0.230	-.0172818	.0715914
SLRPropLoss	-.167014	.0787691	-2.12	0.035	-.3218696	-.0121585
SLRDisplace	-.1612405	.0741867	-2.17	0.030	-.3070873	-.0153938
SLREfffect	-.0097777	.1068296	-0.09	0.927	-.2197984	.2002431
_cons	7.724136	.2140034	36.09	0.000	7.303418	8.144855

```
Variable | Obs Mean Std. dev. Min Max
```

```
-----
```

```
pldaex2015| 415 6.733754 .3490846 5.734417 7.65728
```

```
. sum pldaeex2015
```

Variable	Obs	Mean	Std. dev.	Min	Max
pldaeex2015	415	6.733754	.3490846	5.734417	7.65728

Iteration 0: log likelihood = -1414.3172
 Iteration 1: log likelihood = -1414.3172

Tobit regression
 Limits: Lower = -inf
 Upper = +inf
 Log likelihood = -1414.3172

Number of obs = 415
 Uncensored = 415
 Left-censored = 0
 Right-censored = 0

LR chi2(16) = 133.99
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.0452

VPMVC2	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
GenderD	-1.303866	.8389759	-1.55	0.121	-2.953232	.3454995
Age	.20124	.0303192	6.64	0.000	.1416347	.2608452
Edu2	-.1717602	.7937094	-0.22	0.829	-1.732135	1.388615
NewMaritalStatus	2.543685	.8052676	3.16	0.002	.9605873	4.126783
Townn						
1	7.369847	1.177335	6.26	0.000	5.055292	9.684402
2	4.088677	1.587176	2.58	0.010	.9684045	7.20895
3	6.656002	1.299597	5.12	0.000	4.101088	9.210916
Saltminingactivities	5.305028	4.299326	1.23	0.218	-3.147135	13.75719
Fishingactivities	-3.653139	2.295972	-1.59	0.112	-8.166853	.8605748
OtherLiveli	7.570446	2.999675	2.52	0.012	1.673303	13.46759
SaltWorkHrs	-.433031	.3747519	-1.16	0.249	-1.169766	.303704
FishnWorkHrs	.5109421	.1689819	3.02	0.003	.1787361	.8431481
OtherActHrs	-.8073111	.2576673	-3.13	0.002	-1.313866	-.3007559
SLRPropLoss	1.827825	.897936	2.04	0.042	.0625478	3.593101
SLRDisplace	1.128663	.845698	1.33	0.183	-.5339174	2.791244
SLREfffect	.038742	1.217813	0.03	0.975	-2.355391	2.432875
_cons	79.55084	2.439551	32.61	0.000	74.75486	84.34682
var(e.VPMVC2)	53.41596	3.70819			46.60151	61.22688

Iteration 0: log likelihood = -1701.8262
 Iteration 1: log likelihood = -1701.8262

Tobit regression
 Limits: Lower = -inf
 Upper = +inf
 Log likelihood = -1701.8262

Number of obs = 415
 Uncensored = 415
 Left-censored = 0
 Right-censored = 0

LR chi2(16) = 802.32
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.1908

VPMAVC	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
GenderD	-2.627653	1.677357	-1.57	0.118	-5.925215	.6699087
Age	1.30838	.0606168	21.58	0.000	1.189212	1.427549
Edu2	-.0602904	1.586856	-0.04	0.970	-3.179934	3.059353
NewMaritalStatus	16.33717	1.609964	10.15	0.000	13.17209	19.50224
Townn						
1	63.27731	2.353836	26.88	0.000	58.64984	67.90478
2	56.82893	3.173227	17.91	0.000	50.5906	63.06726
3	60.02776	2.598274	23.10	0.000	54.91974	65.13577
Saltminingactivities	42.20572	8.595605	4.91	0.000	25.30739	59.10406
Fishingactivities	-64.81695	4.590316	-14.12	0.000	-73.84118	-55.79272
OtherLiveli	2.986471	5.997224	0.50	0.619	-8.803636	14.77658
SaltWorkHrs	-3.528894	.7492382	-4.71	0.000	-5.001842	-2.055946
FishnWorkHrs	3.67129	.3378439	10.87	0.000	3.007113	4.335466
OtherActHrs	-2.66246	.5151519	-5.17	0.000	-3.675211	-1.649708
SLRPropLoss	14.93449	1.795235	8.32	0.000	11.40519	18.4638
SLRDisplace	20.4965	1.690796	12.12	0.000	17.17252	23.82048
SLREfffect	.6391224	2.434764	0.26	0.793	-4.147446	5.425691
_cons	-46.13744	4.877373	-9.46	0.000	-55.72601	-36.54888
var(e.VPMAVC)	213.5124	14.82225			186.2739	244.7339

. ta vul1

vul1	Freq.	Percent	Cum.
0	129	31.08	31.08
1	286	68.92	100.00
Total	415	100.00	

. ta vul2

vul2	Freq.	Percent	Cum.
0	3	0.72	0.72
1	412	99.28	100.00
Total	415	100.00	

Iteration 0: log likelihood = -1701.8262
 Iteration 1: log likelihood = -1701.8262

Tobit regression

Number of obs = 415
 Uncensored = 415
 Left-censored = 0
 Right-censored = 0

Limits: Lower = -inf
 Upper = +inf

LR chi2(16) = 802.32
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.1908

Log likelihood = -1701.8262

VPM AVC	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
GenderD	-2.627653	1.677357	-1.57	0.118	-5.925215	.6699087
Age	1.30838	.0606168	21.58	0.000	1.189212	1.427549
Edu2	-.0602904	1.586856	-0.04	0.970	-3.179934	3.059353
NewMaritalStatus	16.33717	1.609964	10.15	0.000	13.17209	19.50224
Townn						
1	63.27731	2.353836	26.88	0.000	58.64984	67.90478
2	56.82893	3.173227	17.91	0.000	50.5906	63.06726
3	60.02776	2.598274	23.10	0.000	54.91974	65.13577
Saltminingactivities	42.20572	8.595605	4.91	0.000	25.30739	59.10406
Fishingactivities	-64.81695	4.590316	-14.12	0.000	-73.84118	-55.79272
OtherLivelih	2.986471	5.997224	0.50	0.619	-8.803636	14.77658
SaltWorkHrs	-3.528894	.7492382	-4.71	0.000	-5.001842	-2.055946
FishnWorkHrs	3.67129	.3378439	10.87	0.000	3.007113	4.335466
OtherActHrs	-2.66246	.5151519	-5.17	0.000	-3.675211	-1.649708
SLRPropLoss	14.93449	1.795235	8.32	0.000	11.40519	18.4638
SLRDisplace	20.4965	1.690796	12.12	0.000	17.17252	23.82048
SLREfffect	.6391224	2.434764	0.26	0.793	-4.147446	5.425691
_cons	-46.13744	4.877373	-9.46	0.000	-55.72601	-36.54888
var(e.VPM AVC)	213.5124	14.82225			186.2739	244.7339

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