

## **Locally-led Adaptation as a Silver Bullet?**

*Complexities, Needs, and Responses in Climate Adaptation at the Volta Coastline, Ghana*

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International Master's Programme in Environmental Studies and Sustainability Science  
(30hp/credits)



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Lund University Centre for  
Sustainability Studies



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A thesis submitted in partial fulfilment of the requirements of Lund University International  
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## **Abstract:**

Sea-level rise increases the exposure of low-lying communities to climate risks along the eastern coast of Ghana, while adaptation responses are reactive and insufficient to secure fishing livelihoods in highly vulnerable areas. To better address needs, Locally-led Adaptation (LLA) promotes just climate governance by shifting power to local actors to enable context-specific and place-based responses. Following a literature review, site observations and twenty-two semi-structured interviews, findings indicate that nature-based solutions could be implemented according to the LLA concept, however, those are not yet widely recognized in Ghana for coastal adaptation, with grey infrastructure being prioritized. De-centralized governance structures, enabling policy framework, and strong collaboration with NGOs are in place to implement LLA, however, horizontal and vertical governance mechanisms are weak, and long-term planning and financial resources are absent to act at a delta-scale. LLA was identified as a potential approach to improving just coastal governance while recognizing its limitations.

**Keywords:** coastal management, grey infrastructure, nature-based solutions, vulnerability, decentralized governance, climate justice

**Word count: 11,995**

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## List of Acronyms

<b>CREMA</b>	Community Resource Management Area
<b>DA</b>	District Assembly
<b>GI</b>	Grey Infrastructure
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>LDC</b>	Least Developed Countries
<b>LLA</b>	Locally-led Adaptation
<b>MANCOGA</b>	Mangroves as Nature-based Solutions to Coastal Hazards in Eastern Ghana
<b>MESTI</b>	Ministry of Environment, Science, Technology, and Innovation
<b>NADMO</b>	National Disaster Management Organisation
<b>NBS</b>	Nature-based Solutions
<b>NGO</b>	Non-governmental Organization
<b>RQ</b>	Research Question
<b>SDG</b>	Sustainable Development Goals
<b>SS</b>	Sustainability Science
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>WACA</b>	West Africa Coastal Areas Management Programme

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## 1. Introduction

Differential vulnerabilities to the impacts of climate change show inequalities globally and call for a more just adaptation response (Coger et al., 2022; Eriksen et al., 2021; Vincent, 2023). Climate action is falling short of reaching the most exposed populations to protect their livelihoods and ensure sustainable development (Boda et al., 2021; IPCC, 2022; Rahman et al., 2023a; Westoby et al., 2020). The estimated costs of adaptation are now 10-18 times higher than international adaptation finance flows, while the gap is widening as the climate crisis hits developing states harder (UNEP, 2023).

Sea-level rise (SLR) poses emerging climate risks in low-lying coastal zones globally, especially threatening deltaic areas where land subsidence further accelerates relative SLR (Nicholls, 2011; Nicholls et al., 2021). In West Africa, such zones host about one-third of the total population, generate 56% of the GDP and are characterized by a low capacity to act on emerging coastal hazards (Dada et al., 2023). Along the coast of Ghana, a 0.55-0.73 metre average SLR is estimated based on 2-4 °C global warming scenarios respectively by the end of the century (Garner et al., 2021). Along the coastline, the Volta Delta is characterized by the highest erosion rates with a 3.5-metre annual average change, as well as higher-than-average population density (Angnuureng et al., 2023; Kusimi & Dika, 2012). Flooding and erosion may lead to the displacement of 400,000 residents in the area under high-emission SLR scenarios (Boateng, 2012; Kusimi & Dika, 2012).

Coastal risks are further exacerbated by social factors, such as urbanisation, population growth, vulnerability, and inadequate governance responses (Babanawo et al., 2022; Dada et al., 2023; Scown et al., 2023). In the context of climate change, the IPCC states that “risks can arise from potential impacts of climate change as well as human responses to climate change”, and that “the diversity of values and objectives of human systems” plays an important role in contextualising risks (Reisinger et al., 2020, p. 4). Discourse on climate adaptation is often framed in ecological, biophysical, economic, and technological terms, however, the social factors, such as governance systems in place are equally important and may lead to maladaptive practices (Adger et al., 2009). More so, in Ghana, as a lower-middle-income country, where financial barriers limit adaptation options, resources are scarce, and decisions need to be made on how, who, what measures and where to prioritize climate adaptation.

While 50% of Ghana’s coastline is vulnerable to SLR, questions of whether and where to deploy hard engineering (“grey”) and nature-based solutions (NBS) are at the forefront of coastal adaptation

decision-making (Boateng et al., 2017). Under increasing climate pressures, grey infrastructure interventions are prioritized at all levels of governance, which are not necessarily leading to the most sustainable outcomes (Charuka, Angnuureng, & Agblorti, 2023b; Charuka, Angnuureng, Brempong, et al., 2023). Hard engineering dominates 20% of the 550 km coastline of Ghana to date; however, some of those structures are eroding, and adverse impacts on fishing livelihoods have been identified, such as intensified erosion hotspots or higher risks associated with fishing (Appeaning Addo et al., 2020; Gbedemah, 2023). NBS, including mangrove estuaries and saltmarshes, show more promising outcomes when it comes to sustaining livelihoods (Aheto et al., 2016a; Dali et al., 2023); however, their use is marginal in Ghana compared to grey infrastructure (GI) in coastal adaptation, with significant knowledge gaps on mangrove extent, as an example (Charuka, Angnuureng, & Agblorti, 2023b).

There is a need to connect levels of governance better, since individual or community-based actions may no longer be sufficient to mitigate the impacts of SLR at a delta scale, and national planning prioritizes GI, which has its limitations in securing livelihoods (Charuka, Angnuureng, & Agblorti, 2023b; Gbedemah, 2023; Sudmeier-Rieux et al., 2021a). Major gaps characterize coastal management at highly vulnerable low-lying areas, such as the absence of a shoreline management plan that would enable a coordinated, regional action connecting coastal adaptation efforts of various districts at the Volta estuary (Charuka, Angnuureng, & Agblorti, 2023b). To counterbalance top-down, engineered adaptation response, local populations exposed need to be at the centre of climate adaptation decisions and their agency strengthened, to enable locally-led adaptation (LLA) that is placed-based and context-specific (Arhin & Tetteh, 2023; Rahman et al., 2023a; Westoby et al., 2020).

LLA promotes more just adaptation pathways, when decisions are delegated to local actors to co-design, implement and evaluate localized interventions, and where resources reach local levels to sustain livelihoods effectively (Coger et al., 2022; Vincent, 2023). There has been political momentum for the LLA concept since 2019, promoted by the Least Developed Countries (LDC) Group at the international fora of the United Nations Framework Convention on Climate Change (UNFCCC), followed by the endorsement by over 100 donors and government bodies (Rahman et al., 2023a; World Resource Institute, 2023). On the other hand, limited empirical evidence is available on the feasibility of the concept, and the readiness of governance structures to delegate both decision-making and financial resources to the lowest appropriate levels (Beauchamp et al., 2021; Rahman et al., 2023a; Westoby et al., 2020). Furthermore, integrated adaptation solutions, such as LLA, have not yet been implemented along the low-lying coastline of the Volta Delta in Ghana, and they are hardly

present in West Africa, where top-down hard engineering approaches dominate (Dada et al., 2023; Rahman et al., 2023a). Thus, knowledge gaps exist around the feasibility of LLA, and its applicability in West Africa and Ghana, in particular.

### **1.1. Thesis Aim and Research Questions**

This thesis aims to explore the potential of LLA as a framework to improve participatory and more just climate adaptation responses at the coastline of the Volta Delta, eastern Ghana. Accordingly, my research questions are:

- RQ1: What are the complexities of climate risks, vulnerability of low-lying communities, and adaptation response in the study area?
- RQ2: What is the readiness to implement LLA, considering enablers and barriers to the concept?
- RQ3: Is LLA a conducive approach to improving coastal adaptation response at the Volta Coastline?

My objective is to better understand the complex needs of low-lying fishing communities in a highly vulnerable deltaic context, current trends in adaptation response, and accordingly, inform policy on alternative pathways through the concept of LLA to better respond to future uncertainties. The underlying assumption is that more climate justice can be reached on the ground by empowering local actors to shape decisions that impact their livelihoods. Furthermore, contextualizing the application of the LLA concept through a Ghanaian coastal case contributes to literature gaps.

### **1.2. Contribution to Sustainability Science**

Sustainability science (SS) addresses the urgency of complex problems, such as climate change, by propagating interdisciplinary research solutions, and mutually addressing complexities in human and environmental systems (Jerneck et al., 2011). This study considers both biophysical risks from SLR and socio-economic factors that stress fishing livelihoods in low-lying coastal areas, to inform adaptation response according to complex challenges and future uncertainties. Therefore, the thesis builds on an interdisciplinary approach, informed by development studies and climate science. Moreover, SS generates new ways of knowledge and decision-making, considering urgent needs and a variety of perspectives, through transdisciplinary, community-based, interactive, and participatory research that involves actors from outside academia (Lang et al., 2012). These principles were

followed by collecting data from diverse stakeholders, including academic experts, governance actors, non-governmental organisations (NGOs) and community key informants. The time frame of this study was not sufficient to co-construct knowledge; however, continued research could have the potential to test the feasibility of the LLA concept and create a learning hub with key stakeholders, thus, leading to transdisciplinarity. The thesis links back to Sustainable Development Goals (SDG) 13, Climate Action for its climate adaptation focus, as well as to SDG 14, Life Below Ocean due to its coastal setting and fishing livelihoods.

## **2. Theory**

### **2.1. Post-development Theory and Climate Adaptation**

Post-development theory gained prominence during the 1990s within development studies, with its agenda not only to reform but to reject the idea of Westernized development in the post-World War era. Thus, reviving local values and alternatives instead of externally imposed top-down approaches and failed development targets (Matthews, 2010). Contrary to other development approaches of scaling up local solutions to a universal model, post-development recognizes the diversity of values in local contexts (Ireland & McKinnon, 2013). It informs climate adaptation by rejecting traditional development projects and calling for more just frameworks that consider the embodied experiences of vulnerable populations, local needs, and aspirations (Matthews, 2004). While billions of dollars are mobilised for development on climate change, little attention has been paid to Eurocentric ideologies behind those decisions, and how those inherently reproduce growth-oriented agendas (Ireland & McKinnon, 2013). As an example, the Adaptation Fund was established in 2001 to mobilize targeted support to developing countries; however, global efforts fail to keep up with adverse climate impacts, and less than 10% of adaptation finance reached local populations who are exposed to climate risks (Boda et al., 2021; Rahman, et al., 2023a; UNFCCC, 2024). Despite good intentions and benefits to some groups, adaptation interventions are prone to reinforce existing power imbalances and vulnerabilities by elite capture and introduce new risks or sources of vulnerability (Eriksen et al., 2021). Among its critiques, post-development is a field of debate rather than a comprehensive framework to outline alternatives to development, however, recent approaches have begun to take a more constructive approach to integrate a pluralism of ideas into climate adaptation (Eriksen et al., 2021; Ireland & McKinnon, 2013; S. J. Matthews, 2010), such as the concept of LLA.

## **2.2. Locally-led Adaptation as Alternative to Development**

Embedded in post-development, LLA is a concept interlinked with climate justice, as it promotes delegating power to the lowest possible level, to enable local actors not only to participate but to lead place-based coastal adaptation actions that address their context-specific needs, and thus, has the potential for more equitable, effective and sustainable adaptation outcomes (Vincent, 2023; Westoby et al., 2021). LLA is also a political movement propagated by LDCs at the UNFCCC, that emerged as a response to slow and inadequate development response compared to climate adaptation needs (UNEP, 2023). Its high-level agenda is to channel adaptation finance where it is intended and needed, based on vulnerability and local needs (Rahman et al., 2023b; Westoby et al., 2021). As a post-development response to 'alternatives', LLA reinforces attention on the agency of local actors to have individual and collective ownership over adaptation actions through emancipatory participation, working with higher levels, but breaking with top-down approaches (Rahman et al., 2023a).

Participatory development is not a novelty in development studies, and LLA contributes to the literature, for example, on Community-based Adaptation, with a stronger focus on connecting communities and sub-national groups with national and international levels, while shifting power and decisions to local actors (Vincent, 2023). By recognizing the need for local framing of climate issues, and more inclusive governance processes across scales, LLA connects individual or community-based adaptation with national and international planning, considering that community focus alone is not sufficient to meet adaptation needs in highly vulnerable contexts, such as the Volta Delta, where cross-scale changes need to be considered, and in a country like Ghana, where climate adaptation is dependent on international donor-funded programmes (Gbedemah, 2023; Poku-Boansi et al., 2020; Vincent, 2023).

The concept of LLA is comprised of eight principles (Table 1). The first targets shifting decision-making to the lowest appropriate level, by leveraging on decentralized governance systems, increasing the autonomy of local actors, and reducing dependency on external agencies on national processes to shape local adaptation needs (Coger et al., 2022; Westoby et al., 2021). Instead of outsiders controlling decisions over decentralized governments, local actors must own decisions and have the power and resources to implement those (Westoby et al., 2021). The second principle takes an equity lens and recognizes that power imbalances, vulnerabilities, and structural inequalities are often reinforced by existing structures. Even if power is shifted to make decisions at local levels, it does not necessarily mean that marginalized voices are heard (Coger et al., 2022; Westoby et al.,

2021). Patient and predictable finance under the third principle means flexible and reliable sources of funding over a long-term horizon, accessible and available for local actors, breaking with current trends of a small proportion of finance flows reaching local levels, while its distribution is hardly linked with vulnerability (Coger et al., 2022; Vincent, 2023). By investing in local capabilities, LLA recognizes that foreign consultants providing short-term, project-based technical assistance prove to be ineffective or unsustainable (Westoby et al., 2021). Instead, community-based organisations, local governments and NGOs have diverse ways of adapting to climate change, whose network, coordination, and agency need to be strengthened by alliances, and peer-to-peer learning (Coger et al., 2022; Westoby et al., 2021). Similarly, recognizing traditional knowledge, community taboos, and indigenous ways of coping with climate hazards are valuable inputs to climate adaptation, which, combined with scientific approaches, need to be integrated into planning processes, to build a robust understanding of climate risks and uncertainties (Coger et al., 2022; Vincent, 2023). When it comes to the principle of flexible programming and learning, both planning, monitoring and evaluation processes should consider local vulnerabilities, priorities, and framings instead of external project-based, quantified metrics, that fail to recognize embodied experiences on the ground, where vulnerabilities often have multiple sources (Omukuti et al., 2022; Westoby et al., 2021). Top-down approaches tend to block transparency and accountability towards local levels, which is reinforced by power imbalances between international donors, top-level decision-makers, and vulnerable communities on the ground. LLA recognises that downward accountability between funders and vulnerable groups needs to be strengthened (Rahman et al., 2023a). The last principle links back to multiple sources of vulnerability and recognises reinforced cross-sectoral and multi-level collaboration to design, implement and monitor context-specific and place-based adaptation action (Rahman et al., 2023a; Westoby et al., 2021).

**Table 1.** Eight Principles of Locally-led Adaptation (Coger et al., 2022)

PRINCIPLES	DESCRIPTION
<p><b>1) DEVOLVING DECISION-MAKING TO THE LOWEST APPROPRIATE LEVEL</b></p>	<p>Giving local institutions and communities more direct access to finance and decision-making power over how adaptation actions are defined, prioritized, designed, and implemented, how progress is monitored, and how success is evaluated.</p>
<p><b>2) Addressing structural inequalities faced by women, youth, children, disabled, displaced, Indigenous Peoples &amp; marginalised ethnic groups</b></p>	<p>Integrating gender-based, economic, and political inequalities that are root causes of vulnerability into the core of adaptation action and encouraging vulnerable and marginalized individuals to meaningfully participate in and lead adaptation decisions</p>
<p><b>3) Providing patient and predictable funding that can be accessed more easily</b></p>	<p>Supporting long-term development of local governance processes, capacity, and institutions through simpler access modalities and longer-term and more predictable funding horizons to ensure that communities can effectively implement adaptation actions.</p>
<p><b>4) Investing in local capabilities to leave an institutional legacy</b></p>	<p>Improving the capabilities of local institutions to ensure they can understand climate risks and uncertainties, generate solutions, and facilitate and manage adaptation initiatives over the long term without being dependent on project-based donor funding.</p>
<p><b>5) Building a robust understanding of climate risk and uncertainty</b></p>	<p>Informing adaptation decisions through a combination of local, traditional, Indigenous, generational, and scientific knowledge, that can enable resilience under a range of future climate scenarios.</p>
<p><b>6) Flexible programming and learning</b></p>	<p>Enabling adaptive management to address the inherent uncertainty in adaptation, especially through robust monitoring and learning systems, flexible finance, and flexible programming.</p>
<p><b>7) Ensuring transparency and accountability</b></p>	<p>Making processes of financing, designing, and delivering programs more transparent and accountable downward to local stakeholders.</p>
<p><b>8) Collaborative action and investment</b></p>	<p>Collaboration across sectors, initiatives, and levels to ensure that different initiatives and different sources of funding (e.g., humanitarian assistance, development, disaster risk reduction, green recovery funds) support each other, and their activities avoid duplication, to enhance efficiencies and good practice.</p>

*Note.* Adapted from Coger et al., 2022. p. 4



### **2.3. Contribution of Locally-led Adaptation to Climate Justice**

Climate justice is a critical element within the literature on LLA, considering the unequal flow of adaptation finance and pressing adaptation needs with a range of power imbalances embedded in governance systems (Rahman et al., 2023a). Distributional justice links back to how resources are allocated economically, who owns decisions over finance and who benefits from adaptation actions. Two major considerations are the small proportion of adaptation finance making it to the local level, and gaps in distributing resources based on needs and vulnerability (Vincent, 2023). Recognition, or cultural justice links back to Spivak and the representation of subaltern groups, those citizens that struggle for recognition as equals, based on class, race, ethnicity, gender or other considerations (Spivak, 1988). LLA recognizes that vulnerability can originate from multiple sources, and transformational adaptation does not automatically translate into more equitable outcomes unless underlying power imbalances are adequately considered (Eriksen et al., 2021; Rahman, et al., 2023a). Thirdly, procedural justice is linked with politics, who represents 'local' within the context of LLA, who can access information, and who has decision-making authority (Rahman et al., 2023a). One limitation acknowledged is clear conceptual guidance linking LLA principles with the three dimensions of justice.

## **3. Methods**

The strategy of the thesis is to present: 1) narratives of the lived experiences of highly vulnerable fishing communities from the Volta Coastline whose livelihoods are adversely impacted by SLR; 2) expert opinions on coastal adaptation challenges; and 3) perspectives of NGOs and governance actors from national to local levels on how they each contribute to addressing localized needs. Thus, a qualitative approach was chosen to draw out these narratives, opinions, and perspectives. Twenty-two semi-structured interviews were conducted with four major groups of stakeholders: community representatives, academic experts, governance actors, and NGOs. Interview findings were triangulated with a literature review and non-participatory site observations at the Volta coastline. A thematic analysis method was applied to code the interview transcripts based on LLA principles.

### **3.1. Literature Review**

A rich literature of peer-reviewed research articles was reviewed to understand the empirical application of the LLA concept, the state of GI and NBS at the Ghanaian coastline, and institutional challenges in coastal adaptation (*Table 2*). A literature search at Web of Science was conducted with four different search terms, between January and March 2024. Abstracts

and conclusions were read to identify relevant articles. Articles were not constrained by publication year. Exclusion criteria included non-English articles, limited focus on Ghana concerning geographical scope or relevance for coastal adaptation. Additional grey literature was identified during field data collection.

**Table 2.** Summary of literature search

SEARCH TERMS	CONSTRAINTS	HITS	EXCLUDED
“LOCALLY-LED ADAPTATION”	Search terms need to include title, abstract or conclusion.	14	2
“GHANA” AND “ADAPTATION” AND “COAST” AND “POLICY” OR “GOVERNANCE”	Search terms need to include title, abstract or conclusion.	32	16
“GHANA” AND “GREY INFRASTRUCTURE” OR “SEA DEFENCE”	Search terms need to include title, abstract or conclusion.	13	1
“GHANA” AND “COAST” AND “NATURE-BASED SOLUTIONS” OR “ECOSYSTEM-BASED ADAPTATION” OR “GREEN INFRASTRUCTURE” OR MANGROVES	Search terms need to include title, abstract or conclusion.	31	18

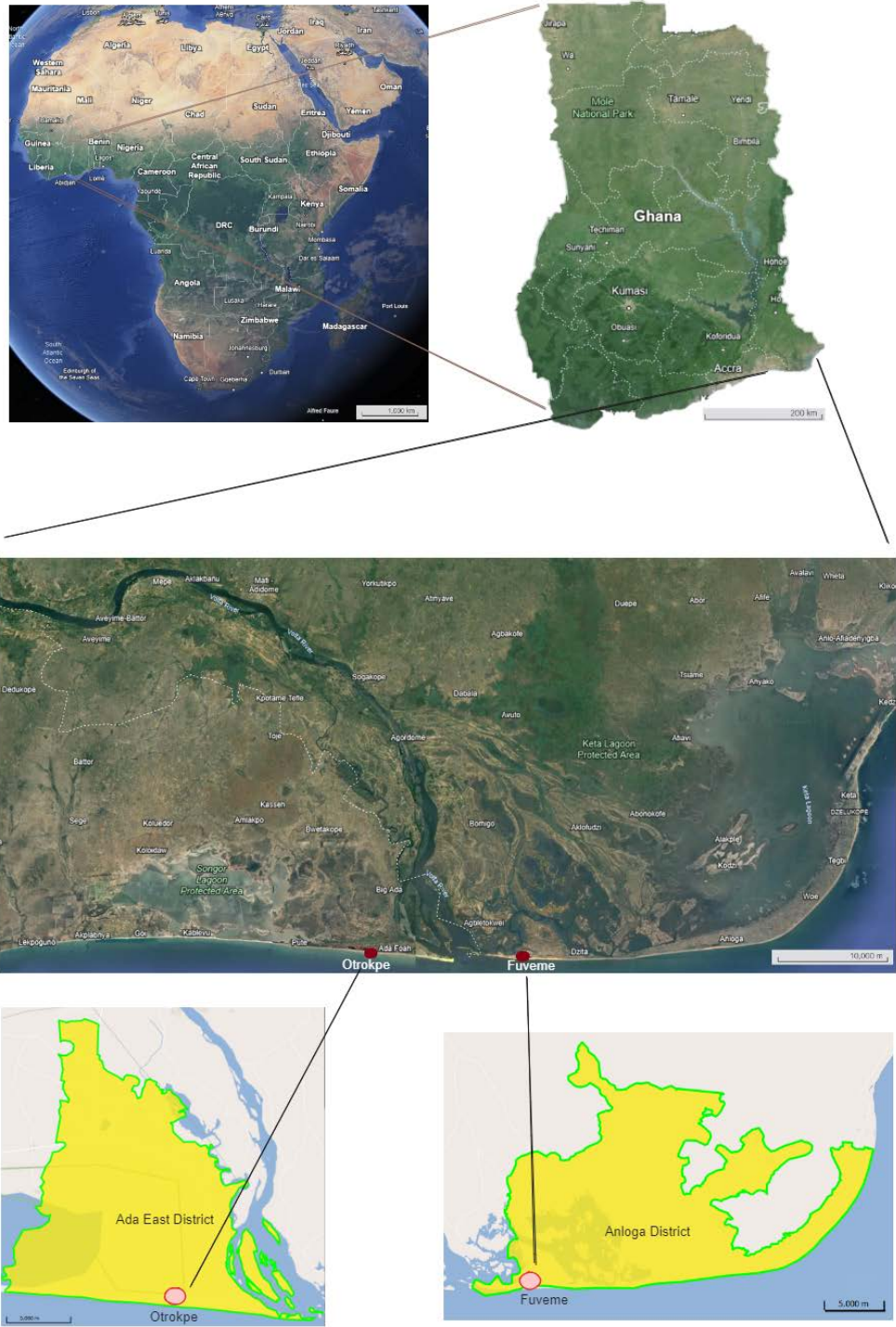
**3.2. Fieldwork Methods**

**3.2.1 Study Area**

Among 50% of the Ghanaian coastline that is vulnerable to SLR, the Volta Delta was identified as the ‘local’ scope of this thesis, for its dynamic nature and highly vulnerable classification (Boateng et al., 2017; Charuka, Angnuureng, Brempong, et al., 2023). This local framing exceeds community boundaries and includes various districts to assess the readiness of LLA for transformative climate adaptation. The aim was to further select districts and communities for key informant interviews, who reside in direct proximity to the Atlantic Ocean and, therefore, whose livelihoods have direct exposure to SLR. Moreover, as a second selection criterion, districts were considered that benefit from either a sea defence wall as a GI or mangrove ecosystems as NBS for coastal adaptation. A Digital Elevation Model in QGIS supported the identification of low-lying coastal areas at the Volta estuary. Additional data on grey infrastructure was added to the GIS map, based on the courtesy and data shared via email by Blessing Charuka, Centre for Coastal Management, University of Cape Coast, Ghana (personal communication, September 26, 2023). Mangrove extent in the area was mapped according to the remote sensing tool of Global Mangrove Watch (Bunting et al., 2018).

Accordingly, two Districts were selected for this study: Ada East with GI, and Anloga with mangrove habitats (Figure 1). Both districts fall within the most vulnerable low-lying areas as mapped by QGIS

and confirmed by academic literature (Boateng et al., 2017; Poku-Boansi et al., 2020). They are part of different regions under local governance structures. Namely, Ada East falls within the Greater Accra Region, while Anloga District is part of the Volta Region. This is important, as the sea-defence structure in Ada East has intensified erosion hotspots eastward in Anloga District (Appeaning Addo et al., 2020).



**Figure 1.** Maps indicating the study area (Own Figure, edited based on *Population Statistics*, n.d.; *Google Earth*, n.d.)

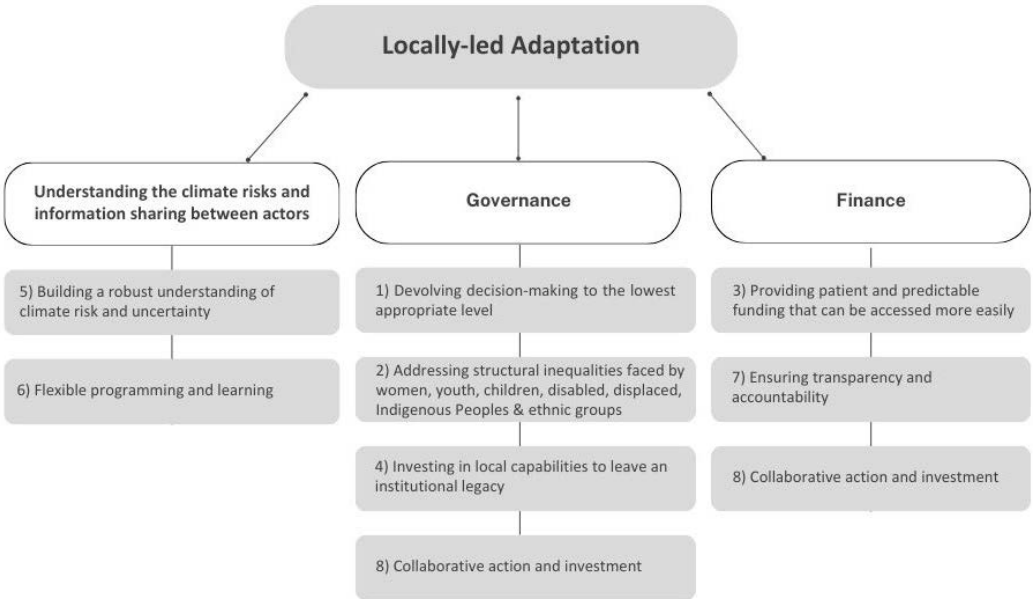
### **3.2.2. Stakeholder Interviews**

Following the selection of districts, stakeholders were mapped and categorized into four groups: experts with academic backgrounds, government representatives at national and district levels, NGOs, and community-based key informants. Separate semi-structured interview guides were developed for the different key informant groups (Appendix 1). In total, 22 interviews were conducted, with 37 participants between the 12th of February and the 4th of April, 2024 in Ghana (Appendix 2). Interviews were carried out in Accra and Cape Coast with academic experts and government representatives. A week-long study at the Volta Delta enabled me to interview local actors. A snowball sampling technique guided the selection of district-level interviews, which led to the further selection of the Otokpe community at Ada East, and Fuveme community and Anloga Districts (Figure 1). District Planners were approached first, who indicated potential members of the District Assembly (DA) with a mandate in climate action for further discussions, as well as NGOs and chief representatives of fishermen and fishmonger women in low-lying communities, whose households and livelihoods are directly exposed to SLR impacts. Interviews were recorded and transcribed manually. Additionally, non-participatory observations of erosion hotspots, the sea defence structures, mangrove habitats and a mangrove firewood market were documented (Figure 3-5).

### **3.3. Data Analysis**

A thematic analysis was used to study the qualitative data obtained from the interviews. The interview questions were developed according to the eight dimensions of the LLA concept and grouped according to three broader themes: 1) understanding the climate risks and information sharing between actors; 2) governance; and 3) finance (Figure 2). Questions on understanding climate risks were asked first, followed by governance-related questions, closing with climate finance. The thematic analysis coded the interview transcripts according to the responses' relevance and connection to the eight dimensions of the LLA concept, and I further grouped them into sub-codes of "barriers" and "enablers". Moreover, three additional codes were created: "nature-based solutions", "grey infrastructure" and "local adaptation", and sub-codes on "neutral", "positive" or "negative" depending on the judgement of interviewees (Appendix 4). NVIVO was used as a tool to code the interviews and structure the key findings. Direct quotes were added to the findings to showcase the narrative represented by different stakeholder groups, aiming to keep a coherent and diversified discussion on coastal adaptation. Additional quotes are listed in Appendix 4. To ensure the anonymity of the interviewees, their personal data are not disclosed, and reference is only made to

the respective stakeholder group they represent: expert, community-based interview, NGO, or government (Appendix 2).



**Figure 2.** The eight principles of the LLA concept, grouped into three themes to guide interview flow and analytical process (Own figure)

**3.4. Ethical Considerations**

Ethical guidelines applicable to the master’s thesis set by Lund University were followed throughout the research process. The consent forms (Appendix 3) were reviewed by Dr Mumuni Abu, demographer, and senior lecturer at the Regional Institute for Population Studies, at the University of Ghana, to cross-check local compliance. The study adhered to ethical considerations throughout the interview process with key informants. This included informed consent, clear communication of research purpose, voluntary participation, withdrawal rights, anonymized results on Lund University’s website, confidentiality, and adherence to no-harm principles. Quotes from interviews are referred to according to codes (Expert/Community-based/NGO/Government) instead of showcasing any personal data that could reveal the identity of key informants (Appendix 2). Language barriers were a particular concern during the community-based discussions with fisherfolks. To address this, a research assistant fluent in Dangme, Ewe and English supported data collection by translation between the languages during the interviews and the transcription process. When English consent forms were not asked to be signed due to language barriers, verbal consent was recorded by participants.

### **3.5. Positionality**

Conducting research as a Hungarian, white, young female and utterly outsider researcher made me reflect and consult on my positionality before travelling to Ghana. My country is landlocked, and my lived realities are not threatened by SLR. I am white, and European, while there is rich academic literature on how African epistemologies are colonized by Eurocentric academia (Etta & Offiong O., 2019; S. Matthews, 2004). I am young, while my interviewed stakeholders were seasoned experts and professionals with rich knowledge or observations on SLR in a Ghanaian context. I am a female, with a more privileged social status than the women I consulted from the fishing communities. My former academic and work background is in the international development sector of donor-funded projects, that may reproduce power inequalities on the ground by top-down programming approaches (Matthews, 2004). All these led to serious doubts about my positionality in conducting research at the Volta coastline. Two women in academia, one from Lund University, and one from the University of Ghana reassured me on two points: I cannot change academic Eurocentrism, but I can contribute to data gaps in Ghana according to my best intention. A second reassurance was to utilize the outsider perspective to observe adaptation challenges in a way a Ghanaian would not, due to place attachments and biases. Accordingly, critical engagement, observations and processing data based on my best knowledge and scientific principles were my underlying principles.

## **4. Results**

This chapter presents findings on stressors that adversely impact fishing livelihoods, as well as adaptation responses to address complex needs, linking back to RQ1. The sub-chapter below summarises findings on how the vulnerability of low-lying communities is exacerbated by both biophysical and socioeconomic conditions.

### **4.1. Vulnerability of Coastal Livelihoods**

In the study area, both communities have lost land and infrastructure due to coastal hazards, and as a result, relocated to higher grounds. On the western side of the Volta Delta, intensified erosion, tidal waves, coastal floods, and human activities such as illegal sand harvesting, the construction of the Tema Harbour, and the Akosombo Dam led to the loss of over 280 meters of land between 1924 and 2008 (Kusimi & Dika, 2012). Within the period, roads, a police station, and the homes of fisherfolks eroded or submerged, prompting communities, like Otrokpe, to relocate to higher grounds (Community-based interviews, 1,2). On the opposite side of the Volta Estuary, both erosion and

accretion intensified attributed to climate change and human influence (Jayson-Quashigah et al., 2013). A school building and the houses of fisherfolks got damaged or submerged, necessitating the relocation of communities like Fuveme to higher lands (Community-based interview, 4). Continued erosion rates at both sides of the Volta Delta imply that the loss of land and infrastructure will continue unless the adaptation response is strengthened (Appeaning Addo et al., 2020).

The livelihood of low-lying fishing communities is further stressed by declining fish catches, rising operation costs and safety risks. As land is submerged, fishing grounds become shallower, forcing fisherfolks to venture deeper into the ocean to cast their nets. This increases both safety risks and fuel costs (Community-based interview, 4). Similarly, in Ada East, fisherfolks shifted their canoe landing site to the Volta River due to the intensity of waves, resulting in extra time and fuel costs (Community-based interview, 1; Figure 3A). Fisherfolks associated shifts in fish reproduction cycles with climate change, and that closed fishing seasons are no longer sufficient to maintain stable catches (Community-based interview, 3). Species that constitute the highest catch of artisan fishers are highly sensitive to climate change (Townhill et al., 2023). Furthermore, annual catches under high-emission scenarios are expected to further decrease (Lam et al., 2012). Unregulated fishing at deeper sea further pressures the abundance of migratory fish such as tuna (Community-based interview, 1). Women-led households face additional difficulties, as fishermen define the price of the daily catch to offset their increasing costs, while fishmongers have limited agency to negotiate. If catches are not rich enough, they are forced to travel to nearby harbours to buy their fresh fish to process and sell (Community-based interviews, 2, 3).

#### **4.2. Adaptation Response**

Both communities expressed deep concerns about future uncertainties, considering the multiple stressors threatening their coastal livelihoods. A shared understanding exists that relocation is no longer a viable option for them. As fisherfolks, their income is inextricably linked to their proximity to the beach, and moving away from the coast would threaten their way of life (Community-based interviews, 1,2,3,4). Moreover, no compensation for loss and damage has been offered during the relocation process, other than post-disaster support in the form of relief items, such as rice or blankets (Community-based interviews 1, 2, 3, 4). As a combination of factors, the idea of another relocation is resisted by the communities, as evidenced by the words of a fishmonger woman: “This is where I grew up, this is where I was born. There is nowhere else to go” (Community-based interview, 2).

#### 4.2.1. Community-based Adaptation

Alternatives to relocation at the community level are reactive, not coordinated, small-scale adaptation responses, predominantly self-financed by community members, with limited potential to sustain coastal livelihoods under climate uncertainties. As an example, fishermen in Ada East relocated their canoes to the Volta River from the coastal landing beaches (Figure 3A), as the sea-defence structure and intensified tidal waves caused damage when docking (Community-based interview, 1). To mitigate elevated safety risks at sea, fisherfolks receive an early warning alert by text messages, that signal the intensity of waves (Community-based interview, 1, 4). Fishmongers form self-help groups, to put their savings together to microfinance their losses or needs, called *susu* (Community-based interview, 2). Furthermore, communities are involved in small-scale beach fortification measures, such as installing sandbags, or waste materials like plastic or tires to protect their homes, particularly at island communities at the estuary (NGOs, 2, 3). Hoteliers implement hard engineering measures to prevent erosion on their property, with fortified concrete walls (NGO, 2).

Communities further propagated delta-scale adaptation; however, their recommendations were not appraised by higher levels of governance. In both communities, fishermen proposed dredging the estuary, to mitigate the strength of tidal waves that the shore, through the DA or their respective fishing associations (Community-based interview, 1, 3). In other cases, when a sand block built up due to tidal waves and sediment movement at the delta (Figure 3B), communities of Anloga District gathered to dig a passage, to unblock the river flow towards to ocean (NGO, 4). These findings imply the need for more coordinated solutions at a delta scale to sustain the livelihoods of fishing communities, as community-based small-scale solutions proved insufficient: “As community members, we feel powerless to prevent the relentless erosion caused by the raging sea (Community-based interview, 2)



**Figure 3.** A-Relocated canoe harbour at the Volta River; B-Sand block between the Volta and Atlantic Ocean blocking waterways, near Fuveme (Photos taken by the author, 28 February 2024)



#### **4.2.2. Grey Infrastructure**

GIs are desired and prioritized coastal adaptation solutions at the Volta Delta due to their immediate effect on fortifying beaches (Appeaning Addo et al., 2020; Charuka, Angnuureng, & Agblorti, 2023c). At Ada East, the sea defence comprises 22 groynes covering a distance of 16 kilometres along the western coast of the Volta Delta (Charuka, Angnuureng, & Agblorti, 2023c). While two phases were initially planned, only the first phase has been completed since 2013, taking partial effect (Appeaning Addo et al., 2020). The sea defence system has not performed as intended; although erosion has been slowed down, it has not been fully halted (Figure 4B). Despite this, key informants from Ada East, including fisherfolks from the Otokpe community and officers from the DA, appraise the GI-based approach to coastal defence, and desired completion of planned works:

“Thank God, the government, over the years, built partial sea defence for us now. Fantastic, it solved the problem around 70%. The rate of erosion that took place before was severe. It was through our consistent discussions and feedback that the construction of the seawalls was initiated. However, the incomplete state of the seawall now stands as our primary challenge” (Community-based interview, 1).

The sea defence at Ada East has negative impacts on ecosystems and was evaluated as maladaptive for intensifying erosion hotspots eastward (Angnuureng et al., 2023; Babanawo et al., 2022). Ecosystems, like sea turtle habitats are disrupted, as they lose nesting beaches, and are hit to the groynes during high tide (Government, 1,4) Another adverse impact includes intensified erosion hotspots eastwards. Among other unprotected coastal communities in Anloga District, a key informant from Fuveme shared their deep concern on how coastal hazards have intensified at the Eastern shore of the Volta Delta: “We realized that the construction of the sea defence is the primary cause of the flooding, which is destroying our habitat” (Community-based interview, 4). Erosion rates in these areas are observed to reach 7 metres per year (Angnuureng et al., 2023). Moreover, the sea defence at Ada East is eroding itself, due to the lack of maintenance (Expert 4,5, Figure 4A).



**Figure 4A:** Eroding sea-defence structure; B-Erosion at Otrokpe despite sea-defence structure (Photos taken by the author, 27 February 2024)

#### **4.2.3. Nature-based Solutions (NBS)**

Mangroves are abundant resources in the study area, but they are threatened by a variety of human stressors, including firewood extraction, water pollution, littering and sand mining (Dada et al., 2023; Dali, 2023; Kutir et al., 2022; Nunoo & Agyekumhene, 2022; Rubin et al., 1999). Conservation efforts are underway by the Forestry Commission and NGOs, targeting inland lagoons at Ramsar sites. However, communities continue to extract mangroves for firewood, fishing nets and construction materials on their private land, which hinders conservation efforts due to conflicting local priorities (Aheto et al., 2016a; Nunoo & Agyekumhene, 2022). The persistence of mangrove markets in Anloga District confirms these findings (Figure 5).

Despite the recognition of mangroves as NBS for coastal protection globally, afforestation or reforestation efforts at the Ghanaian coastline are not widely recognized, and conservation efforts only target inland areas (Sudmeier-Rieux et al., 2021b). Academic experts, NGOs, and local governments increasingly recognize their potential in coastal adaptation for its ecosystem benefits compared to GI, however, these solutions are not yet upscaled or financed (Expert, 1,2). Mud plains between the ocean and the lagoon have lower salinity rates and are identified as potential sites for afforesting resilient mangrove species for adaptation purposes, which would require proactive and integrated coastal adaptation (Expert, 1). As confirmed by a key informant from the Forestry Commission, utilizing mangroves for NBS requires timely planning:

“Now, people are more used to the hard system. The waves are extremely strong. Our beaches are very fragile. If we want to use the natural system, it should be a bit further away from the coast. So, when the time the beach eroded, up to the mangroves, the mangroves had grown stronger, to withstand those waves (Government, 1)”.

Moreover, there is a low acceptance by communities to use NBS for shoreline fortification (Aheto et al., 2016a; Nunoo & Agyekumhene, 2022). The communities in the two districts witnessed how coconut trees and mangroves were washed away as tidal waves and erosion intensified at the shoreline. There is a general mistrust in how soft structures like trees could secure their livelihoods if rocks and hard engineering have failed to do so (Community-based interviews, 1,2,3,4). Successfully integrating NBS into GI-based coastal protection requires anticipatory planning and locally designed adaptation plans that integrate all relevant stakeholders from the community to the national government, not yet prevalent at local levels (Darko et al., 2022).



**Figure 5:** Mangrove market at Anloga District (Photo taken by the author, 29 February, 2024)

### **4.3. Readiness of Locally-led Adaptation**

To improve context-specific and place-based adaptation response at a delta-scale, the eight dimensions of the LLA are assessed, by identifying barriers and enablers to the concept.

#### ***4.3.1 Devolving Decision-making to the Lowest Appropriate Level***

The National Adaptation Plan policy framework, a decentralized governance system, and strong collaboration between local actors are enabling factors for implementing LLA. The Environmental Protection Agency (EPA) is responsible for the technical coordination of the National Adaptation Plan (NAP) process, which entails mainstreaming climate adaptation priorities into National and District Planning (Government, 3). The NAP endorses principles such as coordinated engagement of the private sector, improved vertical and horizontal coordination, a gender-responsive process, community-based adaptation principles, and ecosystem-based adaptation (*Ghana's National Adaptation Plan Framework, 2018*). DAs implement national policies at the local level through their yearly and 4-year District and Fiscal Plan and coordinate climate action through locally elected assemblymen, community engagements, and NGOs who report to the DAs (Government, 5,7). There is a strong project-based collaboration between DAs and NGOs on localized action, such as beach clean-ups, and mangrove restoration in the study area (NGO, 1, 2, 3, 4).

Climate adaptation and financing decisions are made at the national level despite decentralized structures in place, with limited agencies of DAs to influence decisions. Finance flows at the district level are unpredictable (Government, 5, 7). Resources that DAs can mobilise for climate adaptation are the Internally Generated Funds available for all sectors within their mandate, including education, health, water, and sanitation. Moreover, the allocation of funding among Districts is a top-down process, and transfers are not always materialized at District accounts in full amount (Government, 6). Exceptional funds may be mobilised through the local representation of the National Disaster Management Organisation (NADMO) for post-disaster relief, with limited options for preventive disaster risk reduction (Government, 8). Consequently, public finance is hardly available at the district level to go beyond small-scale adaptation. A new project, the West Africa Coastal Areas Management Programme (WACA) has the potential to mitigate financing gaps for delta-scale adaptation solutions, as it aims to establish a planning process for vulnerable shorelines based on inter-institutional collaboration and participatory principles (MESTI, 2022). However, the implementation and financing decisions remain top-down, even if participatory engagement is endorsed (Expert, 3; Government, 4).

### **4.3.2 Addressing Structural Inequalities**

Women show high adaptive capacity due to their primary caretaker role. Women are responsible for household needs, as fishermen venture at sea. When the catch is insufficient, it's up to the women to satisfy family needs, which require adaptiveness, as shared by an NGO engaged in training fishmongers in the study area:

“Women are adapting, I think, rather better than the men. Because the women, they are home-keepers, they take care of children, feeding, and all that. They do anything to bring some income to take care of the house” (NGO, 1).

Their adaptiveness lies in diversifying household income and reducing dependency on the artisan fishing industry. This may include petty trading, cooking beverages or meals to sell, small-scale fishing at lagoon areas, oyster farming, or trading with firewood (Expert, 4). Upscaling NBS for climate adaptation is an identified pathway to strengthen the agency of women, as their involvement in nursing seedlings, planting mangroves, and safeguarding ecosystems is an alternative way to diversify household income (NGOs, 1, 2, 3, 4).

Despite the variety of ways women adapt to climate change, their representation and participation in decision-making are limited due to existing power structures. Stakeholder meetings before the construction of the sea defence at Ada East predominantly targeted men, and fishmongers relied on information transmitted through their male counterparts:

“There was no time when they called them us as an association (*Fishmongers*), to debrief or engage them (*project implementers*). When they come, they meet the men of the community, the chief, not women” (Community-based interview, 2).

Moreover, within the traditional patriarchal system of Ghana, assemblymen, community chiefs and elders were found to be exclusively men representing Otrokpe and Fuveme communities. Therefore, options remain limited for women to participate in adaptation decisions, despite their resilience to climate change.

### **4.3.3 Providing Patient and Predictable Funding**

Limited planning beyond four-year election terms is a barrier to preventive coastal adaptation at local levels. Short- and medium-term plans have fiscal allocations by DAs. Long-term planning is within their mandate, but budgeting decisions target yearly and 4-year planning (Government, 4, 7). Small allocations are available for climate change issues through the local representation of the

Forestry Commission or NADMO, however, those are not sufficient for integrated and costly long-term solutions, that combine GI and NBS or connect actors for delta-scale, multi-district solutions (Government, 1, 4, 5, 6, 7, 8). These findings from government discussions were confirmed by expert 1, who identified financial barriers as the major gap in proactive adaptation: “Allocation for climate change issues and interventions is very, very low from the government, and that is why the situation is the way it is now”.

Despite small allocations and limited long-term planning, districts have shown proactive approaches to adapt to climate change under future uncertainties. Income diversification training aimed to improve farming productivity, animal husbandry, upscaled fish processing, or alternative livelihoods like hairdressing or sewing (Community-based interview, 3; Government, 3, 8; NGO, 1,2).

To navigate between adaptation needs and financing gaps, strong collaboration is established between DAs and NGOs on accessing climate finance from donor funds and the private sector. Public authorities are not eligible for donor grants, but DAs endorse NGO applications through community engagements, connections, and technical advice. Additionally, the government’s collaboration with the private sector is growing (Government, 3). In the study area, carbon markets are emerging models to scale up mangrove conservation efforts at the lagoon, potentially expanding those efforts at the coastline. In both districts, direct economic benefits are planned for safeguarding mangrove ecosystems on private land through community trust funds, as well as mangrove restoration is positively associated with improved oyster farming outcomes (NGO, 1, 2, 4.). Secondly, hoteliers who own infrastructure in the area are potential contributors to funding localized adaptation actions, whose interest is also to sustain beaches and their property under climate hazards (Government, 2). These findings support, that private sector engagement could mitigate financing gaps at local levels, and strengthen planning for proactive adaptation.

#### ***4.3.4 Investing in Local Capabilities***

Local actors have a good understanding of climate risks by observing changes in the coastline, however, accessing reliable climate information and top-down planning remains a barrier to plan for future uncertainties. One of the main challenges in the districts is knowledge gaps, as summarized by a key informant from the Anloga District:

“As for the District, we only have 4-5 years of planning. The information we have is the little we have. Other than that, we don’t have the budget, to measure the level of SLR, or

instruments, to inform planning decisions. We always rely on the information we pick from the government” (Government, 6)

Local climate facilities are not adequately resourced. A key informant from Ada East shared, that the DA used to have a meteorological office, but they are currently understaffed and no longer capacitated to inform planning about shoreline dynamics (Government, 5). Similarly, preventive disaster risk reduction is undermined by insufficient staff capacities, even if NADMO is proactive in visiting vulnerable communities and ensuring education and awareness-raising (Government, 8). Climate information can be requested from national meteorological services but is not readily available at district levels (Government, 5).

Moreover, climate adaptation is highly dependent on project-based donor funding in the study area, and in Ghana (Poku-Boansi et al., 2020), despite efforts to engage the private sector. Donor dependency can reinforce already existing top-down approaches and elite capture (Eriksen et al., 2021). As an example, NGOs highlighted that projects do not fund staff allowances or the compensation of community involvement in project activities, therefore, reinforcing the exclusion of community members from meaningful engagement. Often, projects rely on the voluntary engagement of community members, who already struggle with bread-and-butter daily challenges (NGO, 2, 3, 4). Secondly, NGOs highlighted difficulties in accessing donor funds that require a track record of stable financial flows, which are not always readily available due to the uncertainties of project funding, even if the technical capacity to implement localized climate action is there (NGO, 1). Other NGOs built their business model to fund their activities from eco-tourism revenues or technical advice to climate-proof construction works, to reduce their dependency on donor funding (NGO, 3, 4; Expert, 1). These findings suggest transforming donor funds by better-enabling conditions to compensate for local engagement.

#### ***4.3.5 Building a Robust Understanding of Climate Risk and Uncertainty***

Local actors have a good understanding of climate risks by observing changes in the coastline, but their capacity to inform decisions depends on the adaptation response prioritized. The adoption of ideas from communities who experience climate impacts and possess rich knowledge from their historical and day-to-day observations benefits localized adaptation (Community-based interviews, 1, 2, 3, 4; Awuni et al., 2023). GI has limited potential to consider local or traditional knowledge, due to its engineered nature. On the contrary, interviews in both districts highlighted that traditional belief systems, taboos and indigenous knowledge have been an integral part of legislation developed to conserve mangrove ecosystems at Ramsar sites (Government 1, 6; NGO 2; Nunoo & Agyekumhene,

2022). The community-resource management area (CREMA) approach has the potential to reinforce coastal adaptation through NBS, thus, promoting better resilience building as promoted by LLA. A variety of ways was shared by Expert 1, on how traditional knowledge could improve coastal adaptation practices:

“If you want to use mangroves as a nature-based solution, the locals know when to plant and when not to plant. When the water is saltier, when the water is fresher. Sometimes, also they can tell you the flood dynamics or regimes. (...) So, you use that also to inform your planning of the project, if you have any restoration activities. They could also tell you which part of the shore is eroding very fast based on their experience in the area., What time of day year the sea is very rough, and so on. (Expert 1)”

The integration of taboos, prohibited access to sacred land, and closed harvest season, among others, improved natural resource management practices, and mangrove survival rates (Government, 1, 4, 6). On the contrary, law enforcement, i.e. legal action against mangrove harvesters at Ramsar-protected sites, undermined community trust in local authorities (Expert, 1; Government, 1).

Further to this, there is growing attention to science-informed decisions to utilize NBS for coastal adaptation. A science-informed approach to mangrove restoration was to plant fast-growing species that communities could harvest and to separate areas with species that no one is allowed to cut (Community 1; NGO 2 &4). Moreover, a scientific project, titled Mangroves as Nature-based Solutions to Coastal Hazards in Eastern Ghana (MANCOGA) aims to bridge knowledge gaps on how to utilise NBS against coastal hazards. At the national level, climate change units have been established at all relevant ministries, and there is an always-increasing scientific understanding at universities of how climate change impacts the coastline and what are the most appropriate need-based measures to mitigate them (Expert, 1).

#### ***4.3.6 Flexible Programming and Learning***

The flexibility of learning systems depends on the adaptation response prioritized. Monitoring the success of GI measures in Ada East revealed limitations in local engagement. Communities observed deteriorating roads during construction, impacts on ecosystems, and eroding sea defence (Figure 4A), but measures were not identified at the district level on how local actors get involved in monitoring conditions, maintenance needs, and follow-up actions (Community-based interview 1, NGO, 1). As confirmed by Expert 6, the monitoring and maintenance culture has major limitations:



“No monitoring system. This is one of the issues raised by scientists. When you implement an adaptation structure, you need monitoring. There is money, but it’s not happening. When the government finishes building the structure, nothing is happening anymore.”

Mangrove conservation has the potential for increased participation in learning, monitoring, and review processes. NBS, even if not yet implemented for coastal defence, could enable more direct community engagement when nurturing seedlings, planting mangroves, and reporting on conditions (NGO, 2, 3, 4). The CREMA approach was already recognized to maintain Ramsar-protected wetlands, that enable communities to collectively rule and enforce rules at a dedicated area, while the government provides an enabling framework by developing bylaws to do so (Government, 1, 4, 6; Dzekoto & Bosu, 2018).

#### ***4.3.7 Ensuring Transparency and Accountability***

Project-based stakeholder engagements promoted accountability towards local levels in the study area. The sea defence in Ada East was predominantly top-down planning, but the DA ensured stakeholder engagement with affected communities before the construction began (Community-based interview, 1,2). Similarly, at Anloga District, local actors are informed about upcoming interventions (Community-based interview, 4; NGO, 4).

Accountability challenges lie when local needs and information are channelled upwards, from communities to the national level. One example is intensified erosion in Fuveme, where communities feel exposed and powerless: “We went to the District Assembly for support, went with a letter to the Works and Housing Committee, but there is no support” (Community-based interview, 4). In other cases, local media and news agencies were utilized by community-based organisations to mobilise local climate action or inform higher levels about climate-induced disasters hitting the study area (NGO; 1, 2, 3, 4). Local media, TV stations and radio were identified as non-governmental platforms to increase transparency and accountability when representation through assemblymen was found slow or ineffective (Expert, 6).

#### ***4.3.8 Collaborative Action and Investment***

Interviews revealed that various institutions working in silos undermine collaborative and proactive climate adaptation at local levels. The capital-intensive hydraulic works that include sea-defence infrastructure at the coastline are within the mandate of the Ministry for Works and Housing. The Forestry Commission is responsible for mangrove conservation efforts, which are interlinked with NBS. NADMO coordinates intra-institutional collaboration for disaster risk management. Ministries

and their local offices work under different umbrellas, which undermines the comprehensive management of coastal areas (Government, 3). Locally managed adaptation solutions are hindered by the absence of a designated office or authority to coordinate climate action. DAs have competent staff representing the work of the main Ministries; however, climate issues are considered cross-cutting, without a designated office taking the lead (Government, 5, 7). As DA mandates cover a large portfolio of sectors with high costs, including freshwater and sanitation, school infrastructure or healthcare, preventive adaptation is hardly prioritized among other pressing needs (Government, 5,7).

Horizontal and vertical collaboration across institutions was identified as ad-hoc, project-based, or topical when disasters hit. During the planning GI in Ada East, a technical committee comprising various line ministries reviewed the GI planning. The Forestry Commission expressed concerns about ecological impacts on marine species and the designs were adapted accordingly (Government, 1). Similarly, a technical advisory committee guides the WACA project, incorporating technocrats from all relevant ministries (Expert, 3). However, these intra-institutional horizontal platforms are project-based for coastal adaptation purposes. At local levels, horizontal coordination was identified to be topical when disasters hit, and urgent response is needed. A recent example is the spillage of the Akosombo Dam, which coincided with tidal waves and flooded communities in the study area. NADMO oversaw intra-sectoral coordination to mobilise post-disaster relief support among local authorities (Government, 8; NGO, 4; Expert, 2). Expert 1 expressed limitations with reactive post-disaster approaches:

“I feel that we should move from curating measures to preventive measures. When there is a report of flooding, every institution wants to jump in. Why? Because there is media attention. So, collaboration is very high. Why don't these same institutions sit together before such disaster happens, and plan to avoid those disasters?”

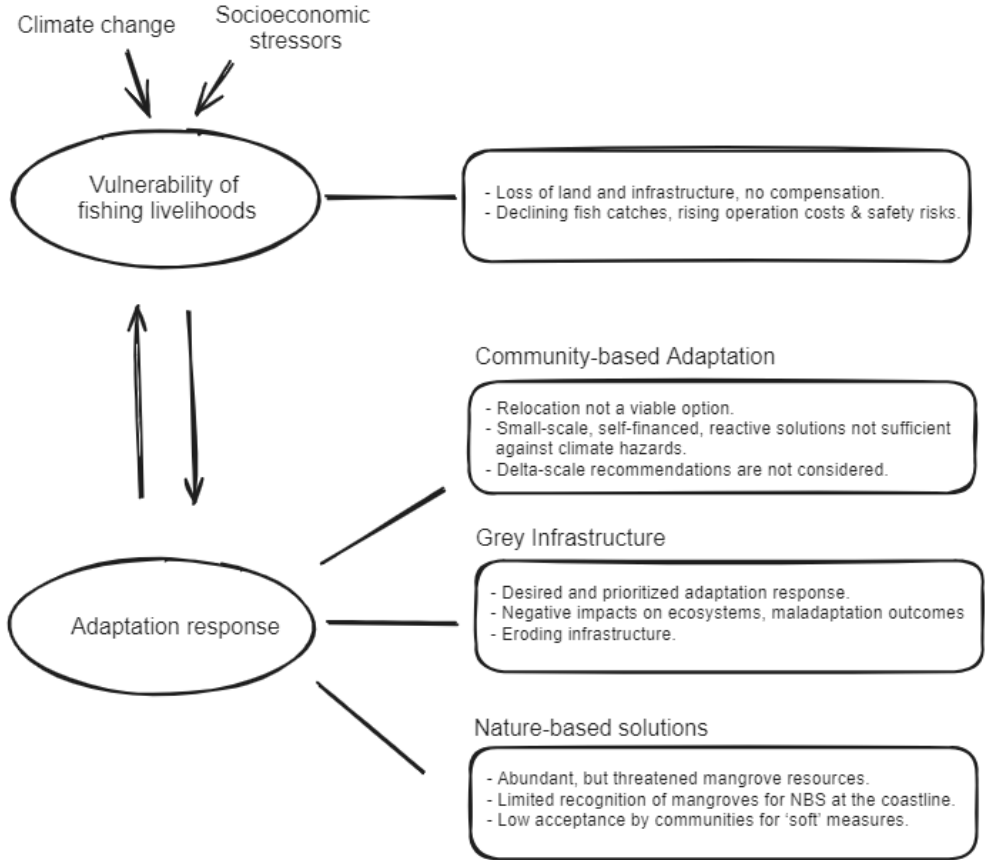
Interviews further identified that as climate adaptation is not within the mandate of a single designated office, delta-scale and integrated adaptation responses remain limited (Expert, 1). At the local level, there is no lead entity for climate action, nor a person in charge of preventive adaptation (NGO 3). Until a lead agency is identified to coordinate institutional efforts, local offices can be reluctant to collaborate (Expert 1). Such an institutional setting is not favourable for long-term or delta-scale planning (Expert, 6). In the absence of clear institutional ownership, there is no horizontal collaboration established between Anloga and Ada East Districts on coastal adaptation, even if they are neighbouring areas, and coastal interventions have cross-scale impacts (Government, 6).

To summarize, seeds of LLA were identified in the two districts, predominantly when discussing mangrove conservation, as a potential NBS at the coastline. These findings highlighted best practices to capitalize on, which included recognition of community-based knowledge systems and locally designed feedback mechanisms through the CREMA approach, gender empowerment by income diversification opportunities through mangrove restoration, and growing interest of the private sector to support local adaptation response. However, major limitations remain, which include a single-sighted GI-based adaptation prioritized at national levels, and limited public funding available for proactive adaptation planning at the district level.

## 5. Discussion

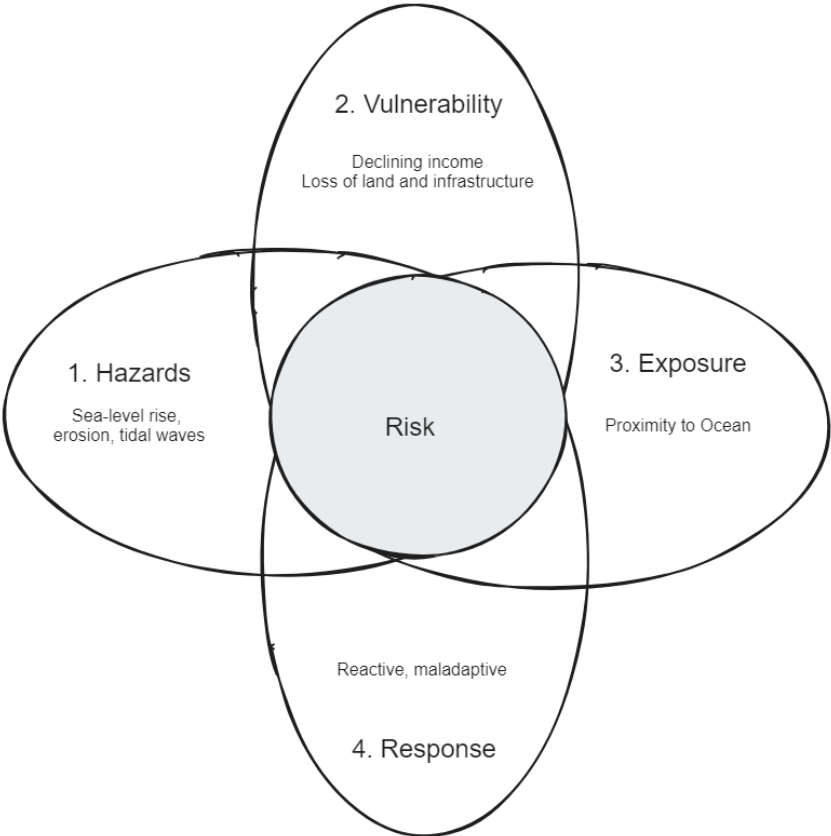
### 5.1. Local Needs and Adaptation Responses

Findings to RQ1 revealed that the livelihood of vulnerable fishing communities is under climatic and socioeconomic stressors, while adaptation responses are reactive, maladaptive, and inadequate against coastal hazards and climate uncertainties (Figure 6).



**Figure 6:** Conceptual summary of livelihood stressors and adaptation response at the coastline of the Volta Delta (Own figure)

Communities’ needs and complex adaptation challenges at the coastline of the Volta Delta link back to the importance of acknowledging social factors that exacerbate biophysical climate risks, such as governance shortcomings, or inadequate adaptation response, that contribute to social vulnerability (Brooks, 2023; Reisinger et al., 2020). Findings from the study area showcase how adaptation response can exacerbate climate risks, according to the latest scientific understanding from AR6, IPCC (Figure 7). Adaptation response was added as a fourth determinant of risk, among hazard, exposure, and vulnerability (Reisinger et al., 2020). Otokpe and Fuveme communities are exposed to coastal hazards, including SLR, erosion and tidal waves, and their proximity to the Ocean increases their direct exposure to climate risk. Their vulnerability lies in lost property and infrastructure and past relocation to higher land, decreasing income from artisan fishing, and increasing safety risks. According to this risk framing, improving adaptation response reduces climate risks at the Volta coastline.



**Figure 7:** Summary of main findings under RQ1 according to the Risk Definition of AR6, IPCC. (Own figure, adapted from (Ara Begum et al., 2022; Reisinger et al., 2020)).

The GI at Ada East slowed down erosion rates, however, it is inadequate to address the complex needs of these communities. The sea defence failed to achieve its intended outcome, as erosion is still taking place threatening the future livelihood of fishing communities. Migrating erosion hotspots

at unprotected beaches eastward is a maladaptive consequence (Angnuureng et al., 2023). Despite the fact that GI cannot be the panacea for the complex challenges, Charuka et al. (2023b), report that it remains a preferred top-down intervention in coastal governance in Ghana. In the absence of continued top-down interventions by the government to halt erosion, communities have taken up reactive, small-scale adaptation solutions such as shifting canoe harbours from landing beaches, forming self-help microfinance groups, or fortifying the beach with sandbags. However, these are insufficient to address future uncertainties (Arkhurst et al., 2023; Gbedemah, 2023).

Combining GI with NBS has been appraised for its potential to address complex challenges associated with SLR and coastal hazards (Aheto et al., 2016), but no traces of evidence of implementing such approaches were found in the study communities. In Southern and Eastern Africa, and globally, mangroves are recognized in coastal adaptation to stabilize the coast, reduce flood risks, and mitigate storm surges, while maintaining healthy (Dasgupta et al., 2019; Nyika & Dinka, 2022; Sudmeier-Rieux et al., 2021b; Sunkur et al., 2023). In Ghana, NBS are less known, and the least considered solution in coastal adaptation, even if conditions at the Volta Delta are favourable for restoring mangrove ecosystems (Angnuureng et al., 2023). LLA was found as a conducive framework to scale up the application of NBS for enhanced adaptation response.

## **5.2. Readiness of LLA and its Policy Implications**

To mitigate risks and improve context-specific adaptation response against uncertainties, the readiness of LLA was tested as an alternative, and enablers and barriers were identified to implement the concept (Table 3). Findings from this study show, that among the enablers of LLA, the National Adaptation Plan recognizes several principles of the LLA concept, decentralized institutions and local governance are in place, there is a good understanding of climate risks through direct observations, and a strong coordination between NGOs and District Assemblies, particularly on mangrove restoration. Among the barriers, both horizontal and vertical coordination is limited for delta-scale shoreline management, and the absence of long-term planning, a designated office to coordinate climate action, and top-down financing decisions on climate adaptation hinder the empowerment of local actors to shape and implement place-based and context-specific solutions. Community engagement and preventive adaptation were found dependent on donor-funded projects in the study area, hindering adaptation response.

**Table 3.** Overview of main barriers and enablers identified to implement LLA at the Volta Coastline

PRINCIPLES	ENABLER	BARRIER
<p><b>1) DEVOLVING DECISION-MAKING TO THE LOWEST APPROPRIATE LEVEL</b></p>	<ul style="list-style-type: none"> <li>• The National Adaptation Plan endorses LLA principles.</li> <li>• Decentralized governance structures are in place.</li> <li>• Strong collaboration between DIs and NGOs on local climate action</li> </ul>	<ul style="list-style-type: none"> <li>• Adaptation finance and planning remain a top-down process, with a limited agency of District Assemblies to influence decisions.</li> </ul>
<p><b>2) ADDRESSING STRUCTURAL INEQUALITIES</b></p>	<ul style="list-style-type: none"> <li>• Women’s adaptive capacity is strong, and their agency could be further reinforced by upscaling NBS in climate adaptation.</li> </ul>	<ul style="list-style-type: none"> <li>• Representation and participation of women in decision-making is limited.</li> </ul>
<p><b>3) PROVIDING PATIENT AND PREDICTABLE FUNDING THAT CAN BE ACCESSED MORE EASILY</b></p>	<ul style="list-style-type: none"> <li>• Strong collaboration between local actors to access climate finance.</li> <li>• Growing interest to invest in climate adaptation by the private sector, with a potential to scale up NBS.</li> </ul>	<ul style="list-style-type: none"> <li>• Limited planning beyond 4-year electoral cycles for proactive climate adaptation.</li> <li>• Insufficient public funds available at local levels for delta-scale adaptation.</li> </ul>
<p><b>4) INVESTING IN LOCAL CAPABILITIES TO LEAVE AN INSTITUTIONAL LEGACY</b></p>	<ul style="list-style-type: none"> <li>• Local actors have a good understanding of climate risks through their observations.</li> </ul>	<ul style="list-style-type: none"> <li>• District Assemblies are understaffed to base planning on reliable climate information and proactively adapt to climate change.</li> <li>• Climate adaptation is dependent on donor funding.</li> </ul>
<p><b>5) BUILDING A ROBUST UNDERSTANDING OF CLIMATE RISK AND UNCERTAINTY</b></p>	<ul style="list-style-type: none"> <li>• Mangrove restoration successfully integrated traditional knowledge systems.</li> <li>• Growing scientific understanding of NBS for coastal adaptation.</li> </ul>	<ul style="list-style-type: none"> <li>• GI has limited options to integrate community-based knowledge systems</li> </ul>
<p><b>6) FLEXIBLE PROGRAMMING AND LEARNING</b></p>	<ul style="list-style-type: none"> <li>• Mangrove conservation has the potential for increased participation in learning, monitoring, and review processes.</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring GI coastal adaptation measures lacks opportunity for local engagement.</li> </ul>
<p><b>7) ENSURING TRANSPARENCY AND ACCOUNTABILITY</b></p>	<ul style="list-style-type: none"> <li>• Project-based stakeholder engagements promoted accountability towards communities.</li> </ul>	<ul style="list-style-type: none"> <li>• Accountability challenges lie when local needs and information are channelled upwards, towards national levels.</li> </ul>

## 8) COLLABORATIVE ACTION AND INVESTMENT

- Projects ensure technical coordination on coastal adaptation at national levels.
- Institutions working in silos undermine collaborative and proactive adaptation.
- Climate adaptation is not within the mandate of a single designated office, which hinders intra-institutional coordination, delta-scale, and integrated adaptation response.
- Horizontal and vertical collaboration across institutions is ad-hoc, project-based, or topical when disasters hit

Interviews revealed that implementing LLA principles could simultaneously address various gaps in coastal adaptation, but there are multiple barriers to its institutional readiness. Gaps in coastal adaptation, as identified by Charuka et al. (2023a) include the 1) absence of a shoreline management plan; 2) multiple regulations and policies affecting the coastline and institutions working in silos to implement them; 3) low efficiency in implementing laws and regulations; 4) the exclusion of key stakeholders including coastal communities and the academic society from decision-making; and 5) single approach in coastal management promoted by political interference. This study implies that LLA has the potential to overcome these gaps, by strengthening integrated solutions that allow improved participation, and by breaking with top-down, highly engineered single approaches, as discussed in the sub-chapters below.

### ***5.2.1. Potential of LLA to Enhance Understanding of Climate Risks and Future Uncertainty***

LLA recognizes that local actors are the best suited to have valuable knowledge and coping mechanisms to improve context-specific adaptation solutions (Westoby et al., 2021). The findings of this study revealed two dimensions of how LLA could address an improved understanding of climate risks: by better capitalising on scientific and local knowledge systems in coastal adaptation, linking back to the dimension of building a robust understanding of climate risk and uncertainty, and by better integrating local feedback into the planning and monitoring of coastal adaptation, linking back to findings on flexible programming and learning.

While local actors have a good understanding of climate risks through observation of impacts on their livelihoods, adaptation response is hindered by knowledge gaps at all levels, particularly on NBS. Locally led adaptation goes beyond the community level and recognises that higher-level planning can benefit climate adaptation, compared to community-based adaptation frameworks (Vincent, 2023). The case study revealed that science-informed top-down planning and project-based (i.e. WACA or COAST project) engagements, education, and awareness-raising are prerequisites to

understanding the potential of NBS for coastal protection and break with the assumptions that soft systems are unable to withstand tidal waves and erosion rates in the study area, as it was found prevalent at Otrokpe and Fuveme communities. Even if those reflect top-down project management approaches, stakeholder engagement, public education and awareness-raising are enabling conditions for integrated coastal adaptation (Charuka, Angnuureng, & Agblorti, 2023a). Limited scientific understanding of NBS at the community level may reinforce existing patterns to extract mangrove resources for short-term gains, instead of safeguarding them for long-term ecosystem benefits. More so, as over-reliance and extraction of natural resources, such as mangroves, remain a major factor behind social vulnerability on the Eastern coast of Ghana (Dovie, 2017).

Another major consideration in LLA is to integrate traditional knowledge systems in adaptation planning (Coger et al., 2022). Findings from the Volta coastline indicate that local bylaws targeting mangrove conservation at Ramsar sites have integrated community taboos, closed harvesting seasons and traditional belief systems into mangrove management planning. Examples from South and Southeast Asia confirm, that integrating strong community participation and inclusion of indigenous knowledge in planning, implementing, managing and monitoring mangrove ecosystems according to LLA principles significantly increased the mangrove survival rate (Rahman et al., 2023b). Moreover, by improved ownership of solutions by local actors, the efficiency of implementing climate laws and regulations could be improved (Rahman et al., 2023a). However, these integrated management approaches are limited in coastal adaptation, as NBS are not appraised. On the contrary, top-down GI solutions have limitations in integrating traditional knowledge into their planning processes by its engineering nature, unless combined with NBS in coastal adaptation. This is in line with Arhust et al. (2022), who found that currently prioritised, highly engineered coastal strategies do not promote the integration of traditional or indigenous knowledge and community efforts into national planning. Examples from the Forestry Commission on its CREMA approach could inform coastal adaptation by integrating elements of planning, implementation, and monitoring with local communities (Aheto et al., 2016b; Dzekoto & Bosu, 2018; Sudmeier-Rieux et al., 2021b),

### ***5.2.2. Potential of LLA to Improve Coastal Governance***

Literature on LLA informs coastal adaptation by reinforcing decision-making at local levels while recognizing its limitations and simultaneously building on national and international levels. Adaptation response needs to take place across scales (Vincent, 2023). Due to the dynamic nature of the Volta Delta, as confirmed by findings under RQ1, one-size-fits-all solutions do not effectively



address local complexities and needs, and national-level decision-making alone does not support vulnerability-based response (Charuka, Angnuureng, & Agblorti, 2023a). Furthermore, community focus alone is not sufficient either (Vincent, 2023). Such principles were endorsed by the WACA project, funded by the World Bank as an international donor, coordinated by MESTI at the national level, and implemented locally through district-level stakeholder engagements and NGO collaboration (MESTI, 2022; World Bank Group, n.d.). LLA acknowledges that not all decisions need to be taken at decentralized governance levels and that top-down engineering solutions can be need-based actions even if not implemented by local actors. In fact, GI was found to be a locally desired solution in both study communities, due to their immediate need to prevent coastal erosion and its proven defence potential along the shoreline, even if these solutions have adverse impacts on ecosystems or maladaptive outcomes elsewhere (Appeaning Addo et al., 2020; Onuma & Tsuge, 2018). However, findings also confirmed, that due to cross-scale dynamics at the Volta Delta, coastal adaptation technologies cannot be generalised, and need to be adapted to local needs and vulnerability (Charuka, Angnuureng, Brempong, et al., 2023). The sea defence alone at Ada East did not prove to address the complex needs of low-lying fishing communities (Figure 6). A contribution, therefore, is to better connect scales.

Another potential of LLA to inform coastal governance is the integration of NBS into adaptation planning at the Volta coastline, for its ecosystem benefits compared to GI (Aheto et al., 2016b; Sudmeier-Rieux et al., 2021b). Empirical evidence on LLA was predominantly available in the forestry and agriculture sectors, and even though its conceptualisation was not yet identified for sectors where top-down engineering solutions are prioritized, like disaster risk reduction at coastlines, findings revealed strong applicability of the LLA concept for mangrove restoration efforts, building on already existing best practices identified (Chalise et al., 2015; Ghimire & Chhetri, 2022; Rahman, Ladd, et al., 2023; Westoby et al., 2020, 2021). Those include collaborative engagement between DAs and NGOs, the inclusion of communities in planning, implementation and regulatory processes, and the integration of traditional knowledge systems. Therefore, a major contribution of integrating LLA into coastal governance is its potential to expand the current GI-based approach with NBS, which could enable more participation and local ownership over adaptation response. The contribution of LLA to NBS links back to two major gaps in coastal adaptation, as identified by Charuka et al. (2023a), including single approaches in coastal management by political interference, and exclusion of key stakeholders from decision-making.

A third way LLA could inform adaptation governance is to better capitalize on the adaptive capacity of local actors (Charuka, Angnuureng, & Agblorti, 2023a). Municipal and District Assemblies are not

sufficiently integrated into sea defence projects, those are rather implemented for them, instead of empowering local actors to be an integral part of prioritized solutions (Owusu et al., 2024). The two districts confirmed, that neither power nor finance is delegated to Assemblies to implement long-term, preventive adaptation at the coastline. Similar power imbalances were recognized when addressing questions of structural inequalities. Women were found to have high adaptiveness and resilience against climate change, which could be better capitalized on during planning processes. A case study from Densu Lagoon in Ghana found, that active engagement of women in nursing, planting, and safeguarding mangrove ecosystems diversified household income and improved mangrove survival rates (Chuku et al., 2022). Therefore, better engagement of women in coastal adaptation could benefit NBS, and simultaneously contribute to gender equality, as in Ghana, domestic power inequalities are coupled with income-generating activities: the more income women can bring to their households, the more power they have to negotiate with their husbands (Acheampong et al., 2023). LLA principles link back to recognising climate adaptation as an integrated social, political and economic process, where a key success factor is to promote stakeholder engagement (Charuka, Angnuureng, & Agblorti, 2023a).

### ***5.2.3. Potential of LLA to Improve Adaptation Finance***

LLA has the potential to reform climate finance by addressing gaps in donor finance that limit local engagement, and by improved collaboration between sectors to channel funding towards needed interventions (Omukuti et al., 2022; Vincent, 2023). Coastal adaptation is largely donor-dependent in the study area, which can limit meaningful participation and sustainable coastal outcomes beyond the projects' timeframe (Poku-Boansi et al., 2020). While donors increasingly embrace LLA principles in their commitments, Omukuti et al. (2022) found that the eight dimensions are not operationalised in finance delivery, as those are predominantly top-down processes with limited experience and capacity to deliver finance to the local level. Evidence from the Volta coastline supported these findings in both districts, where DAs confirmed they are part of project-based interventions through stakeholder engagement and technical advice, but not through benefitting finance for local adaptation. Secondly, NGOs confirmed that grant or donor-funded projects often don't compensate for community engagement or have limitations in staff allowance and, therefore, rely on voluntary participation. This is a major limitation, as it confirms elite capture by excluding vulnerable stakeholder groups, such as women, who need to cater for household needs (Eriksen et al., 2021).

Moreover, as resources are limited, LLA informs climate finance through improved cross-sectoral collaboration, which has the potential to reinforce long-term planning by better aligning sectoral

priorities and exploring innovative ways of financing adaptation (Coger et al., 2022; Vincent, 2023). Better informed and proactive climate adaptation would require the designation of an authority to facilitate, harmonise, and coordinate multi-sector engagement, and therefore break with the institutional silo trends (Dovie, 2017). In the study area, stakeholder interviews confirmed the increasing engagement of private investors in mangrove restoration efforts through carbon markets, implemented by NGOs. Such conservation efforts are not yet interconnected with hard-engineered shoreline protection or preventive disaster risk reduction. Other cases in Ghana showed how better connecting sectoral priorities could benefit investments in coastal protection, such as the coastal engineering solution to protect UNESCO World Heritage sites in the Central Region of Ghana (Mensah, 2022).

Considering enablers and barriers to implementing LLA for improved adaptation response at a delta-scale, and ways in which the concept helps to enhance understanding of climate risk, coastal governance, and adaptation finance, LLA was found especially a silver bullet solution to guide decision-makers on integrating nature-based elements to coastal adaptation.

### **5.3. Towards More Just Climate Governance?**

The dimensions of LLA and policy considerations above are interlinked with the main concepts of climate justice, as it aims to transform adaptation finance allocations, address vulnerability-based needs, and overcome power imbalances between national and local actors in shaping and implementing decisions (Rahman et al., 2023). Distributional, or economic justice addresses who benefits from adaptation action, who bears the burden, and who decides on financial allocations (Lamont & Favor, 2017; Rahman et al., 2023a). Fishing communities at the Volta Coastline, whose livelihoods depend on the proximity of the sea, bear a significant burden and feel powerless against climate risks. Community-based interviews revealed that resettlement to higher ground has been one of the long-term community-based adaptation strategies, without compensation for their loss or damage of land, infrastructure, or property. Climate change-induced displacement within the country has no clear rules or regulations, and no specific laws prescribe the protection of land ownership of displaced communities (Hossen et al., 2019). Moreover, findings under the *investing in local capabilities* dimension of LLA revealed that community engagement may depend on direct income generated for households. Due to limited project-based funding available, participation is often voluntary, and therefore, limited. This links back to the critique of LLA on adaptation finance, and its limited reach to end-beneficiaries (Coger et al., 2022; Rahman et al., 2023a).

Recognitional justice refers to the representation of groups that struggle for recognition as equals, based on class, ethnicity, gender, or other cultural factors (Rahman et al., 2023b; Spivak, 1988). LLA recognizes intersectionality, and that vulnerability originates from multiple stressors. Findings under the *robust understanding of climate risks* dimension revealed that stakeholders at all levels showed a good understanding of climate hazards at the shoreline and the multiple stressors on fishing livelihoods, however, vulnerability-based needs are not always considered. Conflicts may arise and trust between local governments and communities is undermined, when coercive measures, such as arresting fishers during closed seasons or harvesting mangroves in restricted zones, are applied without acknowledging that these illegal activities stem from the basic household income needs. LLA suggests overcoming such conflicts, by integrating community observations, indigenous knowledge, and taboos into planning processes, and by recognizing the root causes of poverty gaps that pressure fishing communities, through strengthening participation mechanisms (Coger et al., 2022).

Representational justice connects to political participation and fairness of decisions (Rahman et al., 2023a). Findings on investing in local capabilities included that climate adaptation is largely donor-dependent (Poku-Boansi et al., 2020), and stakeholder engagement tends to reflect nominal participation to comply with project checklists, instead of fostering meaningful involvement. Moreover, the findings on structural inequalities implied that women's participation in stakeholder engagement is limited compared to men, despite their high adaptiveness originating from their caretaker responsibility to cater for household needs. Moreover, their voices are represented by assemblymen, community chiefs, and male officers at the District Assemblies. LLA acknowledges that persistent power imbalances need to be carefully considered when delegating power to local actors over adaptation decisions, and transforming adaptation practices towards more local engagement could equally reinforce elite capture and already persistent power imbalances (Eriksen et al., 2021; Rahman et al., 2023b).

#### **5.4. Limitations of Study and Next Steps**

Limitations of the study include data gaps related to interviews conducted, geographical scope, and gender parity. Interviews with local actors in two districts and two communities are not representative of the entire coastline at the Volta Delta, and extending the geographical scope could have revealed a more in-depth understanding of lived realities and adaptation options. Moreover, the geographical scope of the research reduced GI to groynes, and NBS to mangrove restoration, as prevalent adaptation responses in the study area, and excluded other GI or NBS solutions. Additionally, interviewees were predominantly male. I aimed to overcome these limitations by a

comprehensive literature review, and by approaching multiple stakeholder groups with diverse perspectives, including academic experts, NGOs, government representatives and community key informants. At communities visited, I approached fishmongers besides fishermen to discuss local challenges and gender issues were widely discussed during the interviews with academic experts, government representatives and NGOs.

Limitations of this study are further attributed to LLA as an academic concept. The conceptualization of the eight principles was found rather complex, as various themes are interlinked, and hard to address as a standalone assessment criterion. As an example, when gaps were identified related to the limited recognition of fishmonger women during stakeholder engagement, those linked back to the dimensions of structural inequalities and transparency and accountability. To avoid repetition, each finding was discussed under one dimension, which was a value-laden process. There is a need for further studies to overcome data gaps on LLA, both in the region and adaptation settings. In addition, both the scope and research methods of this thesis have their limitations and call for a more in-depth institutional assessment of how to empower local actors better to lead their desired adaptation efforts. A potential way forward is to prepare a policy brief to inform decision-makers on how LLA could reinforce coastal adaptation considering the enablers and barriers identified.

## **7. Conclusion**

This study explores the feasibility of the LLA concept to improve adaptation response at the coastline of the Volta Delta in Eastern Ghana. The livelihood of low-lying fishing communities is stressed by climatic and socio-economic factors that increase their vulnerability and exposure to climate risks. Those include lost land and infrastructure, limited options to relocate, declining income stability from artisan fishing, increasing safety risks and direct exposure to coastal hazards by the proximity to the sea. Climate risks are exacerbated by inadequate adaptation responses, that prioritize GI solutions. In Ada East, the sea defence wall failed to halt coastal erosion and intensified hotspots at unprotected beaches eastward. Community-based reactive and small-scale solutions are no longer sufficient to sustain coastal livelihoods, and nature-based adaptation is not yet integrated into coastal adaptation.

To better address vulnerability-based needs, the feasibility of LLA as an alternative approach was studied according to institutional strengths and weaknesses identified. Among the enablers, the National Adaptation Plan recognized key principles of the concept, decentralized governance structures are in place to capitalise on, and there is a strong collaboration between local actors, NGOs and District Assemblies in the study area. However, shifting power to local actors to better

shape and own delta-scale solutions would require reinforced horizontal and vertical governance coordination, and the appointment of an authority on the ground to lead a proactive and integrated adaptation response. Moreover, coastal adaptation is donor-dependent, and long-term planning and associated funds are absent for delta-scale solutions at the local level, which is highly dynamic and requires regional response due to migrating erosion hotspots at unprotected sites.

LLA was found to be a conducive approach to improving coastal governance by its potential to upscale nature-based elements to complement GI measures. The enablers of the concept were predominantly linked with mangrove conservation best practices in the study area. GI measures are decided at national levels, with limited evidence for local engagement. Contextualizing LLA to coastal governance could improve understanding of integrated adaptation response, better inform decisions by capitalizing on local adaptiveness, indigenous and scientific knowledge systems, and strengthen climate finance at the local level through cross-sectoral alignment of priorities and more targeted donor response. Ultimately, it has the potential to improve climate justice at the Volta Coastline, by better integrating local needs and context-specific adaptation responses to national processes. This study contributes to filling in data gaps on the feasibility of implementing LLA in practice in a West African, coastal adaptation context, however, its limitations lie in data gaps and limited geographical scope.

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## 9 Appendices

### 9.1. Appendix 1: Overview of LLA Principles, Guiding Interview Questions according to Stakeholder Group, and Discussion Themes

LLA PRINCIPLE	STAKEHOLDER GROUP	INTERVIEW QUESTIONS	THEMES
<b>1. DEVOLVING DECISION-MAKING TO THE LOWEST APPROPRIATE LEVEL</b>	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• How climate adaptation actions are defined, prioritized, designed, and implemented (i.e. sea defence wall, mangrove restoration)?</li> <li>• How is their success monitored/evaluated? Who is in charge?</li> <li>• Are local actors (i.e. i.e. Regional, District, Town/Municipal, and Community actors) involved at any stage? What is their role?</li> <li>• Do adaptation decisions consider local, traditional, and generational knowledge systems?</li> </ul>	Governance
	Community-based interviews	<ul style="list-style-type: none"> <li>• What do you think the strength of your community is when it comes to protecting your community from the sea-level rise? What do you think needs improvement?</li> <li>• Were you involved in the discussion, maintenance, or any other stages, of the sea defence wall or any other adaptation action in place?</li> <li>• Are you involved in planting or safeguarding the mangrove ecosystem, or any other adaptation action in place?</li> <li>• How does your community decide on what action needs to be taken to protect the livelihoods against rising sea levels? Who judges if the action is successful or not?</li> </ul>	
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>• What is the role of your institution/ organisation in local climate adaptation and the protection of local livelihoods against sea-level risk and climate risks?</li> <li>• Were you involved in the planning, implementation, or management of the seawall solution or any other adaptation action in place?</li> </ul> <p>Are you involved in planting or safeguarding the mangrove ecosystem, or any other adaptation action in place?</p>	

		<ul style="list-style-type: none"> <li>• How does your institution/community decide on climate adaptation actions, such as what needs to be done to protect the livelihoods against rising sea levels?</li> <li>• Who evaluates / judges if the action is successful or not?</li> <li>• What do you think the strength of your district is when it comes to protecting your community from the sea-level rise? What do you think needs improvement?</li> </ul>	
<b>2. ADDRESSING STRUCTURAL INEQUALITIES FACED BY WOMEN, YOUTH, CHILDREN, DISABLED, DISPLACED, INDIGENOUS PEOPLES AND MARGINALISED ETHNIC GROUPS</b>	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• Where do you see the role of women and youth in coastal adaptation? What about national, regional, district-level, and local planning?</li> <li>• Do you know of any successful examples when women, youth, displaced, and marginalized have acted as agents of change in coastal adaptation?</li> </ul>	
	Community-based interviews	<ul style="list-style-type: none"> <li>• Do you think all community members are equally concerned about sea-level rise? Who takes initiatives/actions?</li> <li>• Do you see women and young people equally participating in actions?</li> <li>• What are the main sectors/livelihoods impacted?</li> <li>• Who are the most powerful actors to act, protecting homes or the community?</li> <li>• Who do you think are the most at risk of sea-level rise?</li> </ul>	Governance
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>• Do you think community members are equally concerned about sea-level rise? Who takes initiatives/actions?</li> <li>• What are the main sectors/livelihoods impacted?</li> <li>• Who are the most powerful actors to protect the community against sea-level rise?</li> <li>• Who do you think are the most at risk of sea-level rise?</li> <li>• What is the role of women and youth? Do you know any women or youth-led initiatives where they are agents of change?</li> </ul>	
<b>3. PROVIDING PATIENT AND PREDICTABLE FUNDING THAT CAN BE ACCESSED MORE EASILY</b>	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• Do you know of accessible community financing or local financing for coastal adaptation actions? Any success stories?</li> <li>• If yes, do you think the regional, district, and community actors have sufficient information and capacity to access and manage them?</li> </ul>	Finance

<b>4. INVESTING IN LOCAL CAPABILITIES TO LEAVE AN INSTITUTIONAL LEGACY</b>	Community-based interviews	<ul style="list-style-type: none"> <li>Do you know of any accessible public funding that the community benefitted from to protect their homes/businesses and livelihoods from the sea-level rise?</li> <li>Do you know of any private investors, NGOs, or alternative sources of finance that are available when there is flooding, erosion, or other impacts of sea-level rise?</li> </ul>	<b>Governance</b>
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>Do you know of any accessible public funding that the community benefitted from to protect their homes/businesses and livelihoods from the sea-level rise?</li> <li>Do you know of any private investors, or alternative financing that is available, or benefitted your community before?</li> </ul>	
	Expert & National Government interviews	<ul style="list-style-type: none"> <li>At regional, district, and township levels, is climate action prioritized with assigned staff/department? How are their capacities to understand and manage climate risks and adaptation actions?</li> </ul>	
	Community-based interviews	<ul style="list-style-type: none"> <li>If you, or community members, want to act on rising sea levels, who they can turn to? Do you know who oversees coastal protection at the community/town, and District levels?</li> <li>How do you think local members of the community could be encouraged to participate more in actions that protect homes and livelihoods against rising sea levels?</li> <li>What do you think is missing to better protect your community against rising sea-level? Do you think your voice is heard when decisions need to be made?</li> </ul>	
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>How do you evaluate the local capacities at the District and Community levels to lead actions on climate adaptation?</li> <li>Have you had any past successful collaborations with the local governments on protection against sea-level rise? Maybe other communities or regional councils at the Volta Coastline? If yes, how was the experience working together?</li> <li>If your organisation/institution wants to take climate action, who they can turn to? Do you think there is sufficient information on who oversees coastal protection at the community/town, district, or regional and national levels?</li> </ul>	

<b>5. BUILDING A ROBUST UNDERSTANDING OF CLIMATE RISK AND UNCERTAINTY</b>	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• Is there an understanding of climate risks related to SLR, exposure of low-lying communities at the Volta Delta, and uncertainty at the national, regional, and local governance levels?</li> <li>• How are communication and information sharing between national to community-level actors on climate risks related to SLR, including flooding and erosion?</li> </ul>	Understanding Climate Risk and Information-sharing Between Actors
	Community-based interviews	<ul style="list-style-type: none"> <li>• Have you experienced the impact of sea-level rise and climate change in your community? If yes, could you share more about how erosion, flooding or other risks impacted your lives?</li> <li>• Is your profession/ livelihood (fishing, agriculture, tourism) impacted by any changes related to sea-level rise? If yes, how?</li> <li>• How severe/serious are the impacts on the community? Do you think your community is concerned?</li> <li>• Do you think the seawall/mangroves protect your community?</li> <li>• Do you take any further action, individually or in the community, to protect your homes against the waves and rising sea levels? / Other than mangrove/seawall, what actions do you take in your community to protect your livelihoods?</li> <li>• Do you have information on what will happen in the future regarding Sea-level rise, erosion, and flooding? Where do you normally get informed?</li> </ul>	
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>• Have you experienced the impact of sea-level rise in your District? If yes, could you share more about how erosion, flooding or other risks impacted the lives of community members?</li> <li>• How do community members react to these changes?</li> <li>• Do you think the seawall/mangroves protect your community?</li> <li>• Do you know of any further adaptation action in place at the community level?</li> <li>• Do you think you have sufficient information on what will happen in the future concerning Sea-level rise, erosion, and flooding? Where do you normally get informed?</li> </ul>	

6. FLEXIBLE PROGRAMMING AND LEARNING	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• Is there a willingness by the Government to programme and develop monitoring and learning systems together with local actors?</li> <li>• Are there any forums, conference, or coordination platforms that bring the different levels together involved in climate adaptation, from the national to community level?</li> </ul>	Understanding Climate Risk and Information-sharing Between Actors
	Community-based interviews	<ul style="list-style-type: none"> <li>• Have you participated in any community forums or discussions on the topic of changing sea levels, or actions to protect your community?</li> <li>• Have you met NGOs, experts or local governments before to discuss the impacts of rising sea levels on your homes and livelihood?</li> </ul>	
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>• Is there any forum, conference, coordination platform, or event that brings together communities in the Volta coastline on challenges related to sea-level rise? If not in the Volta area, in your community? If yes, have you participated before? What are the experiences?</li> <li>• Were there forums, or programmes organized by the national or local government, that enabled collaborative programming of local adaptation action on sea-level rise, erosion, or coastal flooding?</li> </ul>	
7. ENSURING TRANSPARENCY AND ACCOUNTABILITY	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• How are financing decisions made on climate adaptation at the Government? Do local actors participate in the decision?</li> <li>• Is there a willingness to channel climate adaptation funding towards local levels at the government, to strengthen their capacities and lead community/local action?</li> </ul>	Finance
	Community-based interviews	<ul style="list-style-type: none"> <li>• Do you have information on what actions get funding and what not, when it comes to sea-level rise and protection of your communities from waves, storms, flooding and erosion? Who decides?</li> <li>• Have you received any financial support before, to protect your home or livelihood? Or any compensation for losses that may have happened?</li> </ul>	
	Local Government & NGO	<ul style="list-style-type: none"> <li>• What actions get funding and what not, when it comes to sea-level rise and coastal adaptation? Who decides?</li> </ul>	

<b>8. COLLABORATIVE ACTION AND INVESTMENT</b>	interviews	<ul style="list-style-type: none"> <li>• Have you benefitted from any local financing before, related to coastal protection?</li> <li>• Is there knowledge and capacity to access public, donor or NGO financing at the local government / at your institution?</li> </ul>	
	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• Is there coordination between districts, and towns/communities on SLR and coastal hazards?</li> <li>• Is there coordination between sectors at the district and towns/communities' level, (i.e. DRR, climate adaptation, health)?</li> </ul>	Governance
	Expert & National Government interviews	<ul style="list-style-type: none"> <li>• Are there alternative funding mechanisms in place for climate adaptation (i.e. private-public partnerships), that would enable flexible financing at local levels?</li> </ul>	Finance
	Community-based interviews	<ul style="list-style-type: none"> <li>• Do you have information on how changes in the sea level is connected with natural disasters, health impacts, or impacts on agriculture, fish stocks, etc?</li> </ul>	Governance
	Community-based interviews	<ul style="list-style-type: none"> <li>• Do you know of any accessible public funding that the community benefitted from to protect their homes/businesses and livelihoods from the sea-level rise?</li> <li>• Do you know of any private investors, NGOs, or alternative sources of finance that is available when there is flooding, erosion, or other impacts of sea-level rise?</li> </ul>	Finance
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>• Are there any collaborative platforms that discuss how tourism, health, fishing, agriculture, health, or other sectors are impacted by sea level rise and local climate risks?</li> </ul>	Governance
	Local Government & NGO interviews	<ul style="list-style-type: none"> <li>• Do you know of any accessible public funding that the community benefitted from to protect their homes/businesses and livelihoods from the sea-level rise?</li> <li>• Do you know of any private investors, or alternative financing that is available, or benefitted your community before?</li> </ul>	Finance

## 9.2. Appendix 2: Overview of Interviews Conducted

CODE NAME	SPECIALISATION / EXPERTISE	NUMBER OF PARTICIPANTS	LOCATION
<b>EXPERT 1</b>	Community-based coastal resources management, mangrove conservation	1	Accra
<b>EXPERT 2</b>	Climate change adaptation and governance, coastal aquatic systems	1	Accra
<b>EXPERT 3</b>	Climate change impact assessment and adaptation in delta regions, vulnerability, and risk assessment to sea level rise	1	Accra
<b>EXPERT 4</b>	Marine and coastal resources management, earth observation, mangrove extent mapping	1	Accra
<b>EXPERT 5</b>	Coastal erosion and climate impact assessments	1	Accra
<b>EXPERT 6</b>	Coastal geomorphology, erosion, remote sensing	1	Cape Coast
<b>GOVERNMENT 1</b>	Mangrove conservation and governance	1	Accra
<b>GOVERNMENT 2</b>	Coastal vulnerability, climate finance	1	Accra
<b>GOVERNMENT 3</b>	National Adaptation Planning, private-public partnership and carbon markets	1	Accra
<b>GOVERNMENT 4</b>	Local governance, NBS	1	Ada East
<b>GOVERNMENT 5</b>	Local governance, NBS & Grey infrastructure	2	Ada East
<b>GOVERNMENT 6</b>	Local governance, NBS	1	Anloga



<b>GOVERNMENT 7</b>	Local governance, NBS & Grey infrastructure	1	Anloga
<b>GOVERNMENT 8</b>	Local governance, disaster risks	1	Anloga
<b>NGO 1</b>	Mangroves as nature-based solutions, income diversification of fish processor women	2	Accra
<b>NGO 2</b>	Mangrove restoration, community engagement	1	Ada East
<b>NGO 3</b>	Community engagement, SLR impacts on local livelihoods and tourism	1	Ada East
<b>NGO 4</b>	Mangrove restoration, community engagement	1	Anloga
<b>COMMUNITY-BASED INTERVIEW 1</b>	SLR impacts on fishing livelihoods	11	Ada East
<b>COMMUNITY-BASED INTERVIEW 2</b>	SLR impacts on fishing livelihoods (women)	3	Ada East
<b>COMMUNITY-BASED INTERVIEW 3</b>	SLR impacts on fishing livelihoods (man, woman)	2	Anloga
<b>COMMUNITY-BASED INTERVIEW 4</b>	SLR impacts on fishing livelihoods	1	Anloga

**9.3. Appendix 3: Example of Consent Form**

**CONSENT FORM**

Title / Theme of Study:	<b>The Battle Against Sea-level rise and the Agency of Local Actors in Coastal Ghana: Exploring the potential of Locally led Adaptation at the Volta Delta</b>
Principal Investigator:	<b>Borbála Blanka Bretus</b>

**General Information about Research**

The aim of the study is to identify the readiness of locally-led adaptation in the low-lying coastal zones in Ghana, including what is the local understanding of climate risks posed by sea-level rise, how residents/local actors have reacted and adapted to climate changes so far, how adaptation decisions are made and responses change in different communities with seawall defence infrastructure or mangrove ecosystems in place, and what are the strength and weaknesses for a regional, but locally-led adaptation approach in the Volta Delta.

This interview will take approximately one hour, is voluntarily and anonymous, meaning that names and any information that would reveal the identity of the participant will not be published.

The questions are about the 8 principles of locally led adaptation. I will guide the discussion, pose the questions, and the participant is expected to answer them based on their own expertise and experience. The participant is encouraged to share any further information, thought or idea freely that comes to their mind.

**Compensation**

This interview contributes to the data collection of a master’s thesis project of Lund University in Sweden. Collected data will only be used for the master’s thesis. There is no direct financial benefit or compensation for the participation, but a small gift will be distributed as a sign of gratitude and token of appreciation to help, and for taking the time to answer the questions. The gift will be handed over at the end of the interview.

**Benefits/Risks of the study**

The findings of the study will be distributed among the participant, hoping to inform stakeholders engaged both at the central planning, at the regional and community-levels to get prepared for locally led adaptation initiatives, as global adaptation financing may evolve to directly benefit local actors. Physical or mental risks are not associated with participating in this study.

**Confidentiality**

If the participant agrees, the interview will be recorded, and the recording securely stored at Lund University’s secured data portal. The interview recording will not be shared with third parties.

The master's thesis will be published at a public website managed by Lund University Library. The confidentiality and anonymity of interviewees will be maintained in the published master's thesis, meaning that any interview minutes or data used will not include the personal details of the participation.

### **Withdrawal from Study**

The participation is voluntary, and participants may withdraw at any time without penalty. The participant will not be negatively affected if they decline to participate or withdraw from the study at any point. The participant can freely decide not to answer specific questions if he/she considers sensitive.

### **Contact for Additional Information**

I will be available to respond to questions or any research-related inquiry at:

- Name of Researcher: Borbála Blanka Bretus
- Title: Master's Student at Lund University International Master's Programme in Environmental Study and Sustainability Science;
- Email: [bretusbori@gmail.com](mailto:bretusbori@gmail.com);
- Phone/Whatsapp: +36309553539.

<b>PARTICIPANT AGREEMENT</b>
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**"I have read or have had someone read all of the above-asked questions, received answers regarding participation in this study, and am willing to give consent for me to participate in this study. I will not have waived any of my rights by signing this consent form. Upon signing this consent form, I will receive a copy for my personal records."**

---

Name of Participant

---

Signature or mark of Participant

---

Date

**If participants can neither read nor understand the form themselves, a witness must sign here:**

I was present while the benefits, risks, and procedures were read to the volunteer. All questions were answered, and the volunteer has agreed to take part in the research.

\_\_\_\_\_

Name of witness

\_\_\_\_\_

\_\_\_\_\_

Signature of witness / Mark

Date

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

\_\_\_\_\_

Name of Person who Obtained Consent

\_\_\_\_\_

\_\_\_\_\_

Signature of Person Who Obtained Consent

Date

#### 9.4. Appendix 4: Overview of Thematic Codes and Search Results

THEMES	CODE	SUB-CODE	TOTAL NUMBER OF FILES (TRANSCRIPTS)	TOTAL NUMBER OF REFERENCES
GOVERNANCE	1. Devolving decision-making to the lowest appropriate level	General	3	4
		Barrier	11	17
		Enabler	12	16
GOVERNANCE	2. Addressing structural inequalities faced by women, youth, children, disabled, displaced, Indigenous Peoples and marginalised ethnic groups	General	6	6
		Barrier	9	21
		Enabler	8	11
FINANCE	3. Providing patient and predictable funding that can be accessed more easily	General	5	5
		Barrier	9	21
		Enabler	8	11
GOVERNANCE	4. Investing in local capabilities to leave an institutional legacy	General	1	1
		Barrier	13	26
		Enabler	9	14
UNDERSTANDING CLIMATE RISK	5. Building a robust understanding of climate risk and uncertainty	General	5	5
		Barrier	11	18
		Enabler	18	42

<b>UNDERSTANDING CLIMATE RISK</b>	6. Flexible programming and learning	General	5	5
		Barrier	14	32
		Enabler	19	55
<b>FINANCE</b>	7. Ensuring transparency and accountability	General	3	4
		Barrier	13	27
		Enabler	17	24
<b>GOVERNANCE &amp; FINANCE</b>	8. Collaborative action and investment	General	3	4
		Barrier	13	27
		Enabler	17	24
<b>ADAPTATION RESPONSE</b>	Nature-based Solution	Neutral	7	11
		Negative	9	13
		Positive	9	11
	Grey Infrastructure	Neutral	4	4
		Negative	12	18
		Positive	9	11
	Community-based Adaptation Strategy	-	14	37

## 9.4. Appendix 5: Supporting Narratives of Findings

THEMES	CODE	QUOTES	INTERVIEW
GOVERNANCE	1. Devolving decision-making to the lowest appropriate level	“I think a big challenge is that, they work (government institutions) under different big umbrellas, so working together is a big issue (...) Even reflected in data collection, you don’t know where the data is sitting. (...). Now what is mentioned is a comprehensive management of the coastal areas, where all institutions work together. But it’s still on paper. There are gaps”	Government, 3
		“I have said on many platforms, I like NADMO very much, but sometimes we should be proactive, not just NADMO, but the other organizations too. NADMO comes in to relieve some of the pain, which is very good, but working with other institutions to put preventive measures in place is important. So, at the point where the disaster is there, collaboration is very high. But before that, most institutions are working in silos, and I think we have to come together and then increase our collaboration on that front”	Expert, 1
		“For the long-term, we know from the geographical information, that the area that is vulnerable to impacts of erosion, we always have the fear that the future will be of worse scenario unless we undertake infrastructure and nature-based solutions to address and mitigate the impact. Other than that, the future will be worse for us. As for the District, we only have 4 or 5 years of planning. The information we have is the little we have. Other than that, we don’t have the budget, to measure the level of SLR, or instruments, to inform planning decisions. We always rely on information we pick from the government”	Government, 6
GOVERNANCE	2. Addressing structural inequalities	“There was no time when they called them us as an association (Fishmongers), to debrief or engage them (project implementers). When they come, they meet the men of the community, the chief, not women. But there was a time when I was invited as leader of the fishmonger, and debriefed how the whole construction would go (Ada sea defence)”	Community-based interview, 2
		“Women are adapting, I think, rather better than the men. Because the women, they are home-keepers, they take care of children, feeding, and all that. They do anything to bring some income to take care of the house”	NGO, 1
FINANCE	3. Providing patient and predictable funding that can be accessed	“But as how much of it goes back to the local communities to develop and safeguard their lives against these disasters, in terms of budgeting, it’s inadequate. (...) It is the truth that allocation for climate change issues and interventions is very, very low from the government and that is why the situation is the way it is now”	Expert, 1
		“In the Ada and Volta area, there is a lot of potential. There is a growing private sector interest in that area, and	Government, 2

	more easily	different in-kind investments, like resorts, and recreational activities. If the private sector is interested, they would provide some resources to protect that”	
		“Whatever happens, they decide what needs to be done and they release the money. Unless the council give the green light, money is not released. It’s a national-level council (...) Locals can say what they need, (...) they have the right to say whatever they want, but influencing the decisions, there are different big men to do that. As an example, if they say we need sea defence, the government decides what they think is more appropriate or what they have money for”	Expert, 5
<b>GOVERNANCE</b>		“In the Assembly (Ada East), we had the meteo office here. They had staffed station, with gadgets, to monitor dynamics. In terms of their activeness, they are not as active as before. They are understaffed (...). They gave climatic information. Especially when the full team was here. Not anymore”	Government, 5
	4. Investing in local capabilities to leave an institutional legacy	“It’s not a joke, we are incapacitated in this office, but we are trying to do our best. We are always on the ground. Even tomorrow we go into a sensitive region, to do education to the general public and communities what to do in case of disasters. It’s not an easy task”	Government,8
		“Each level, including local levels, are supposed to have climate units be integrated with local planning. (...) Yes, there is supposed to be assigned staff working with climate adaptation, and a strategy to guide them, with a budget to do the work they are doing. Planning officers are quite vibrant, they are involved in almost everything that is going on, and there are technical people that come in. Over the years, efforts were there to build their capacities when it comes to climate adaptation”	Expert, 2
<b>UNDERSTANDING CLIMATE RISK</b>	5. Building a robust understanding of climate risk and uncertainty	“If you want to use mangroves as a nature-based solution, the locals know when to plant and when not to plant. When the water is saltier, when the water is fresher. Sometimes, also they can tell you the flood dynamics or regimes. (...) So, you use that also to inform your planning of the project, if you have any restoration activities. They could also tell you which part of the shore is eroding very fast based on their experience in the area., What time of day year the sea is very rough, and so on”	Expert, 1
		“They understand climate change. What they don’t understand is nature-based solutions. Climate change, they are experiencing it. (...) Most of them believe that big rocks will defend them from the sea. In other countries, like Bangladesh, they use mangroves as NBS for coastal hazards. Some species of mangroves can grow on the beach. (...) We just need time and resources to practice these pilot things. (...) We can do education, but if there are no resources to implement action, it doesn’t make sense (...). Avicennia can be cut and regrown, it regerminates, but other species don’t. Still, people cut mangroves for fish traps and firewood. They cut a lot”.	NGO, 4



<b>UNDERSTANDING CLIMATE RISK</b>	6. Flexible programming and learning	<p>“I think it’s important to start with communities. If they own the project, they need to know what they are going to do. For example, if they are not involved in a mangrove project, and you go out there, and design for them, they will not do it, you cannot ensure they would stop cutting it. Right from the beginning, if you engage them, they bring their ideas and their frustration, and then they can own the project. Same for sea defence: this is the design we have; this is what we implement, but it’s their livelihood that suffers. You need to engage them from the beginning”</p>	Expert, 5
		<p>“When it comes to post-intervention monitoring, it has to be the Ministry of Works and Housing, with the District Assembly and Regional Offices. To be honest with you, that could be always a challenge (...) It’s important, that operation and maintenance is part of the discussion. All these projects take a lot of money when it comes to sea defence, it’s a top-down approach, contracts are awarded at the national level, the district is not so much involved”.</p>	Government, 2
		<p>“It’s the Ministry of Water and Housing who did it (sea defence). It was Phase I, and now it’s Phase II, but the government changed. They were supposed to come and reinforce it for Phase II. Since then, they didn’t touch it (...) Unless you lobby hard, on how people getting the impacts or being cut off and relocated, nothing would happen”</p>	Government, 4
		<p>“No monitoring system. This is one of the issues raised by scientists. When you implement an adaptation structure, you need monitoring. There is money, but it’s not happening. When the government finishes building the structure, nothing is happening anymore”</p>	Expert, 6
		<p>“Nature-based interventions are unfortunately not government-led. In Keta, there are initiatives to create, so-called community resource management areas managed by an institution from outside, to protect the ecosystem (...). Nature-based interventions are more bottom-up.</p>	Expert, 4
		<p>“All decisions are made at the top. The role of the Local Assembly, or District is to implement them, but they cannot do it. They need resources from the government. Even if they know what needs to be done, sea defence or mangroves, money is not there. Local Assemblies cannot do anything without approval at the top”</p>	Expert, 4
<b>FINANCE</b>	7. Ensuring transparency and accountability	<p>“I went to the District Planner, the Assembly. They said the project is bigger than here. And gave reasons. I made my point here and there (...) I wrote already a letter about sea level problems, it is already on the alliance platform (Canoe and Fishing Gear Owners Association), so everyone can read it.”</p>	Community-based interview, 1
		<p>“We do not know of any plan because there is no change coming up but every year the situation repeats and all</p>	Community-

<b>GOVERNANCE &amp; FINANCE</b>	8. Collaborative action and investment	we see is rice being given to the affected community members”	based interview, 3
		“We went to the District Assembly for support, went with a letter to the Works and Housing Committee, but there is no support”	Community-based interview, 4
		“In terms of information getting back to the government, it depends on Assemblymen, apart from media, that picks up erosion events. Assemblymen are supposed to send whatever information they have up to their District Assembly. The response is not always the best. There is always a delay. In terms of events happening, the media has a role, it does a lot. That’s how it gets to the national level”	Expert, 6
		“If you look at the WACA project, there is a technical committee, made of all technical agencies that are connected on the coast. Ministry of Lands, not only looks at mangrove restoration but also how mangroves can be integrated into coastline management. Hydro Departments, who are looking at hard engineering, also talk to the Lands Commission and identify how to blend natural resources. EPA is looking at the environment, and how the Hydro and Lands Commission work is integrated, while the Forestry Commission is also there to come together. There is a technical committee, made up of technocrats from these agencies, and ministries, all talking together”	Expert, 3
		“There is a need to develop a more deliberative line of intervention. It’s only when there is a tidal wave or hazard, when something is happening, or actions are done. Properties will go soon. Long-term planning, it’s not happening in Ghana”	Expert, 6
		It's (coastal adaptation) not consolidated and put under the umbrella of one institution. Where an office feels like you are taking their job from them, those can be reluctant to try to collaborate, and because everybody is doing something with climate change, sometimes getting to know who the lead stakeholder is can be a problem. So it has been a bit challenging in trying to work with the local government offices”	Expert, 1
		“So, until one institution sees there is an issue and reports to the other, there's nothing structured that happens every quarter, such as, let us meet to think about interventions to prevent this. (...) No, there's nothing like that. So until we see a potential threat or until that thing happens, there is no planning. And it was NADMO I reported to, not the EPA. But every institution does some planning, but in terms of intra-institutions, nothing happens.”	
		We (Anloga District) don’t have active collaboration with them (Ada East District). (...) Ada is in Greater Accra. We are in Keta, Volta Region. Ada is not part of the Volta region. However, last year there was a meeting to	Government, 6

		<p>draw a coastal plan for coastal communities, that brought together communities across the coastline. Also, the Volta River Authority brought together districts (9) along the catchment area”</p>	
		<p>“In the WACA project, it’s more of an extent of need that defines financial allocation. It’s not community-driven. It’s defined by the level of challenge. If erosion is more in a particular area, the extent of need will be determined by the technocrats, based on the erosion rate. If one area is eroding more, the funds available will target that area.” (Expert 3)</p>	<p>Expert, 3</p>
<p><b>ADAPTATION RESPONSE</b></p>	<p>Nature-based Solution</p>	<p>“Sea defence was not able to fully solve the problems. Mangroves would be the best to prevent sea erosion. But I did not see the funds coming. When you visit other communities, they also request sea defence, because sea enters their houses. So, the government thinks this is what they need (...). To me nature-based solutions should be the solution”</p>	<p>Government, 4</p>
		<p>“As a country, we don’t have a policy for coastal erosion management. Now we are trying to develop one. The idea of NBS was not well fractured. If you see coastal erosion management on the coast, mangroves haven’t played a key role”</p>	<p>Expert, 3</p>
		<p>“The interesting dynamic at the mangrove swamps, even at Ramsar sites, is that the government does not own the land: it’s co-owned by the communities, and families, who can give them out to people to manage them at certain times of the year. The community decides how mangroves are utilized”</p>	<p>Expert, 4</p>
		<p>“When it comes to mangroves, the Forestry Commission provides seedlings. Implementation is done by NGOs. They come in, do the restoration, logistics”</p>	<p>Expert, 5</p>
		<p>Currently, there are no ongoing projects that are specifically doing nature-based solutions on the beaches directly, not that I’m aware of. (...) All the restoration has been away from the beach”</p>	<p>Expert, 1</p>
		<p>“If you look around, some mangroves, are not replanted for nature-based solutions. It’s replanted because it’s cut. Not for NBS against adaptation. It’s not intentional for adaptation purposes”</p>	<p>Expert, 3</p>
		<p>“When it comes to sandy beaches: those are not suitable for the restoration of mangroves, unfortunately. Maybe, for coconuts, is possible. Then, just below the dune, which is between the beach and lagoon, where there are mud floods, is where mangroves can survive (..) Now, people are more used to the hard system. The waves are extremely strong. Our beaches are very fragile. If we want to use the natural system, it should be a bit further away from the coast. So, when the time the beach eroded, up to the mangroves, the mangroves had grown stronger, to withstand those waves. If you plant mangroves today, I am not sure you can use them to</p>	<p>Government, 1</p>

	prevent erosion”	
	“The way the soil is, it will be difficult for any form of trees, or coconut trees to grow, due to salinity. So, they didn’t plan to grow any kind of coconut tree as of now (the Government)”	Community-based interview, 2
	“Since 20 years ago, the sea has washed all the mangroves away. (...) Anytime we engage in tree planting, the trees die off as a result of the salty nature of the sea”	Community-based interview, 3
	“The people came to speak with us concerning how to plant trees and even people came to practice it but they (mangroves & coconut trees) eventually died off.”	Community-based interview, 4
	“One time, in 2014-2015, some of the communities along the coast started replanting coconut trees as nature-based solutions. The quantity and the volume couldn’t withstand the tides. The motivation did not continue”	NGO, 3
Grey Infrastructure	“The sea defence wall comes from the central government. Local actors have a say, yes. Normally these interventions are demanded by communities. Most of these communities are full-time fishermen. They would want something to protect their shoreline, canoes, and fishing lines. Their houses are located there. If those are lost, the government needs to touch additional funding to resettle them“	Expert, 4
	“Right now, the best would be to reinforce the sea defence, but it’s a lot of money. We engage and educate; this is what we can do (District Assembly). For the sea defence, there is no money at the Assembly. But we do the community engagement”	Government, 5
	“Thank God, the government, over the years, built partial sea defence for us now. Fantastic, it solved the problem around 70%. The rate of erosion that took place before was severe... It was through our consistent discussions and feedback that the construction of the seawalls was initiated. However, the incomplete state of the seawall now stands as our primary challenge”	Community-based interview, 1
	“We are not safe at all unless there is a sea defence; it's the only thing that can save us ... when the construction is done the sea will not have any impact on us, we are suffering because of the absence of the sea defence”	Community-based interview, 4

	<p>“It is strong (tidal waves) but with the support of the sea defence it is not able to cause havoc as it used to, the sea defence serves as a blockage to the tidal waves and reduces the force it comes with it”</p>	Community-based interview, 3
	<p>“I was happy when I was in Ada, I was part of the committee of the sea defence system. When people were concerned with the turtles, we agreed that we needed adequate space for the turtles to nest. (...) Now there is a space for turtles to nest. The beach is not accruing as expected, but it’s not eroding as it used to be. But the studies show that the turtles use the natural beach as the ones with sea defence”</p>	Government, 1
	<p>“Sea defence kills the sea turtles, they are hit to the defence when there is high tide. Nature-based can prevent erosion, but also benefit marine species”</p>	Government, 4
	<p>“So what is happening, the whole idea behind the Ada coastal defence was to trap sediment and build the beach. However, the structures constructed were not properly done, and they are not performing as effectively as expected. There seems to be erosion going on”</p>	Expert, 3
	<p>“But if this is Phase 1 (Ada East sea defence), they need to come and finish Phase 2, so that it would be fully secured (groynes)... Ever since the seawalls were constructed, every year, we have noticed gradual erosion of the walls by the sea, even though it hasn't been able to overflow them. This erosion is why we are advocating for Phase 2”</p>	Community-based interview, 1
	<p>“But the seawall was not fixed properly, not completed, I praise they came and reworked it, so our difficulties with erosion stopped. We pray they will come back and finish it properly”</p>	Community-based interview, 2
Community-based Adaptation Strategy	<p>“What we do (NADMO), what the government can support, is to bring back business to normal. Alternative livelihoods programmes. To help already collapsing businesses to make sure businesses can secure livelihoods. It is the responsibility of the government and district“</p>	Government, 8
	<p>“We have and Association, Canoe and Fishing Gear Association of Ghana, and Meteo Agency, who give us daily forecast. We spread that, among fishing folks, how to go and when during good and bad weather times. This is how we are managing that now.”</p>	Community-based interview, 1