Assessing the processes of determining Adaptation finance needs: A comparative study of African NDCs.

By

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ABSTRACT

Nationally Determined Contributions (NDCs) represent a key framework for climate action, outlining each country's commitment to reducing greenhouse gases and adapting to the impacts of climate change. In Africa, the significance of adaptation finance in supporting the implementation of NDCs cannot be overstated, especially with most African countries requiring external financial support. To close the financial gap, the UNFCCC requested developing countries provide cost estimates for implementing their NDC commitments. However, most countries struggled to compute these estimates, and only a few managed to indicate both the estimates and costing processes. Previous research has looked at the overall cost of adaptation in developing countries; however, a comprehensive assessment to evaluate the robustness of processes used to determine adaptation finance needs expressed in NDCs is still lacking. This thesis solely assesses 27 African countries that submitted their 2021 NDCs in English. It documents the various approaches adopted and assesses their robustness against criteria based on the 'elements of adaptation communications', a framework adopted from the World Resource Institute. The framework provides guidelines on reporting national circumstances, assessing impacts, risks, vulnerability, adaptive capacity, and identifying financial needs. The thesis investigates costing methodologies and whether governments provided detailed information on impact and vulnerability assessments related to the adaptation options that require financial support. This qualitative analysis of the African NDCs revealed that most countries state the figures without providing information on the methodologies or processes of costing the adaptation actions. Although there is a growing recognition of the need to include detailed costing methodologies in NDCs, such reporting currently needs to happen. A context-based reporting format should be developed and standardized at a regional level, which can work as a blueprint for countries with similar national circumstances and exposure to climate impacts.

Keywords: Africa, NDCs, Adaptation finance and Climate change

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Dedication to my late brother, Lincoln K. Murape.

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ABBREVIATIONS AND ACRONYMS

AfDB – African Development Bank

CBDR – Common but differentiated responsibilities.

COP – Conference of Parties

GDP – Gross Domestic Product

GHG – Greenhouse Gases

INDC – Intended Nationally Determined Contribution

IPCC – Intergovernmental Panel on Climate Change

NAP – National Adaptation Plans

NDC – Nationally Determined Contributions

NGO – Non-Governmental Organisation

OECD – Organisation for Economic Co-operation and Development

UNEP – United Nations Environmental Programme

UNFCCC – United Nations Framework on Climate Change

WGII – Working Group II

WMO – World Meteorological Organisation

WRI – World Resource Institute

Chapter 1: Introduction

1.1 Background

As climate change impacts continue escalating, each country must develop adaptation plans that reduce vulnerability and enhance its resilience (Noble et al., 2014; Dixit et al., 2022). It is equally crucial to robustly assess and allocate adaptation finance, especially for developing countries vulnerable to climate change and requiring external financial support (Micale, Tonkonogy & Mazza, 2018; UNFCCC, 2022a). Recent reports indicate that Nationally Determined Contributions (NDCs) have become a standard instrument among developing countries for communicating such financial needs (Dixit et al., 2022; Fransen et al., 2022). However, despite NDCs holding the potential to drive substantial climate-resilient actions, the accuracy and transparency of the cost calculations for adaptation finance needs within these commitments face scrutiny (UNFCCC, 2022a).

Recent adverse weather conditions across the globe show that most parts of the world have experienced some form of climate change but with no uniform impacts (IPCC, 2022). For instance, the AR6 WGII report outlines that "the vulnerability of ecosystems and people to climate change differs substantially among and within regions; driven by patterns of intersecting socio-economic development, unsustainable ocean, and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism, and governance" (IPCC, 2022:12). The report elaborates that over 3 billion people currently live in highly vulnerable contexts to climate change. Africa's vast geographical diversity and reliance on climate-sensitive sectors such as agriculture and natural resources make it one of the more vulnerable regions (IPCC, 2022).

UNEP (2022) suggests that as global temperatures continue rising, adaptation measures become increasingly urgent to alleviate the growing risks of extreme weather conditions, the rise of sea levels, and changing rain patterns. However, climate finance is the driving force behind the implementation of adaptation measures since substantial financial resources are required to adapt and minimize the effects of climate change (UNFCCC, 2020). Therefore, it is crucial to robustly establish adaptation financial needs and where the funds are most needed (Kissinger et al., 2019; Halimanjaya et al., 2021a).

The Paris Agreement reaffirms the significant role of finance in tackling climate change (UNFCCC, 2020). In the last decade, the COP under the UNFCCC has made provisions that assist developing countries in obtaining financial resources for implementing the objectives of the UNFCCC (AfDB, 2021). For instance, according to the principle of '*common but differentiated responsibility and respective capacities'*, developed countries should mobilize climate finance, considering developing countries' needs and priorities (UNFCCC, 2020). To achieve some degree of transparency and accountability, the UNFCCC established reporting mechanisms that involved each country that is a party to the Convention, reflecting their financial contributions in submitted NDCs (Fransen et al., 2019). This would help determine the financial assistance each developing country needs from external parties to tackle climate change (UNFCCC, 2020, 2022a,b).

Fransen et al. (2019) state that NDCs are at the center of the Paris Agreement and fundamentally the best instrument for communicating adaptation financial needs. 'Article 13' of the Paris Agreement

confirms this, asserting that "developing country Parties should provide information on financial support needed and received in their NDCs" (Halimanjaya et al., 2021:16). While National Adaptation Plans can provide this information, only a limited number of African countries have formal NAPs, making it difficult to ensure comparability in this assessment. Moreover, NDCs serve as the primary sources of adaptation finance information. As highlighted by the African Development Bank (AfDB, 2021), NDCs often include more comprehensive details on financial needs and cost estimates.

Nevertheless, NDCs and finance are interconnected because climate finance enables countries, especially developing ones, to implement the actions outlined in their NDCs (Mohan, 2022). Without adequate funding, many countries would struggle to adapt to climate change (AfDB, 2021). The latest NDC public registry data updates show an increasing need for adaptation finance, especially from African countries (UNFCCC, 2022c). However, despite an increase in reporting of financial needs, the UNFCCC has noted that adaptation finance needs are possibly underestimated due to the complex nature of estimating adaptation costs (Micale, Tonkonogy & Mazza, 2018; UNFCCC, 2022a).

Within these NDCs, assessing and determining adaptation finance needs is pivotal in ensuring effective and targeted adaptation strategies (Noble et al., 2014; UNFCCC, 2022a). This process involves several essential steps, such as conducting vulnerability and risk assessments to identify sectors and regions most susceptible to climate impacts, evaluating the potential consequences of these impacts, and identifying suitable adaptation options (Noble et al., 2014). Once adaptation strategies are identified, a detailed estimation of the associated costs is performed, encompassing the initial investment and ongoing operation and maintenance expenses (Singh et al., 2020; UNFCCC, 2022a). However, estimating financial needs has been challenging for most developing countries as a result of limited technical capacity (Guzmán et al., 2022). The absence of guidelines has also resulted in countries employing different levels of detail and methodologies to identify their climate finance needs (AfDB, 2019). Halimanjaya et al. (2021) point out that inconsistencies in processes and methods in determining needs remain a challenge in closing the gap between what is received and what is needed.

1.2 Research Question and Objectives

Drawing from a comprehensive review of existing literature, reports, and case studies, it is clear that the costs to adapt have only been tallied without assessing the robustness of the costing methods and processes used to estimate the reported figures (AfDB, 2021; Guzmán et al., 2022). Overlooking these processes has resulted in significant discrepancies between budgeted and actual costs, slowing the implementation of adaptation measures(UNFCCC, 2022a). Therefore, assessing these processes will establish whether the methods used for cost estimations are robust and give a precise presentation of needs (Guzmán et al., 2022).

The main objective of this research is to identify the processes used to estimate adaptation costs in African NDCs and examine the extent to which they are described about adaptation finance needs. Guided by an assessment framework proposed by Dixit et al. (2022), the research investigates the consistency and comparability of the methods employed across different NDCs. It also attempts to identify variations and best practices within NDCs. The research assessment looks at data gaps and quality issues that may affect the precision of cost calculations. The transparency of the processes is

evaluated, including the extent to which methodologies and data sources are disclosed and accessible to stakeholders.

As mentioned earlier, NAPs are excluded from this research because not all countries have a formal NAP document, leading to potential inconsistencies in the availability and comparability of information. Including NAPs could have resulted in an uneven analysis, as some countries may lack standardized or detailed adaptation plans. By focusing solely on NDCs, which are more uniformly available across countries, the study ensures a more consistent and comparable assessment of adaptation finance needs.

Lastly, the research explores the extent to which adaptation finance needs are described in the NDCs assessed. The research also identifies the basis for the cost estimations or lack thereof. Furthermore, gaps and associated implications, such as potential opportunities and limitations, will be addressed for future studies.

The research seeks to answer the following specific questions:

1. What processes and methods are used to determine financial needs in NDCs?
2. How effective/robust are the processes and methods in determining financial needs?
3. To what extent are the processes and methods described in NDCs?

1.3 Thesis Outline

This section briefly summarises the outline of this thesis. Chapter 1 introduces the research topic and describes the background information. It also provides the research aim, research questions, and main objectives. Chapter 2 is the literature review on the main topic of the research, which is adaptation finance needs and Nationally Determined Contributions in the African context. The review also examines the processes and methodologies used to estimate adaptation finance needs. Chapter 3 focuses on the methodological approach followed in this research. It outlines the rationale behind selecting the countries assessed and then describes the data collection and analysis methods. It also provides the framing of the research findings, which are crucial in achieving the purpose of this study. Finally, the chapter highlights limitations that potentially influence the research outcome. Chapter 4 discusses the research findings through a country analysis and comparative study, while Chapter 5 concludes the thesis and provides recommendations for future studies.

Chapter 2: Literature Review

This chapter discusses the current literature on climate change adaptation, particularly in developing countries. The main focus is on the processes and methods of determining the financial needs for implementing adaptation measures. Furthermore, the chapter explores the challenges, opportunities, and gaps this thesis intends to fill. The review starts by providing an overview of climate change adaptation and later describes its prominence in Africa. Since the thesis is grounded on a comparative study of African Nationally Determined Contributions (NDCs), the chapter also discusses the origin and current developments of NDCs and their relevance in implementing adaptation measures. Finally, the chapter reviews the findings from climate change adaptation as a component of Nationally Determined Contributions. The aim is to highlight the correlation between the two in establishing and reporting adaptation financial needs. The chapter concludes by discussing the best practices concerning adaptation finance needs.

2.1 An Overview of Climate Change Adaptation

The rise in the emission of greenhouse gases continues to accelerate global warming, bringing the world closer to abrupt and irreversible climatic changes (UNEP, 2022). With the negative impacts mounting higher than anticipated, adaptation is inevitably a lifeline that sustains and improves ecosystems and human well-being (UNEP, 2021, 2022). According to OECD (2009), climate change adaptation aims to secure sustainable development from potentially harmful climate change effects. Dixit et al. (2022) describe adaptation as a means of adjusting to both the present and future effects of climate change; in doing this, negative impacts are minimized. At the same time, societies and ecosystems become more resilient to these changes. Furthermore, climate change adaptation involves developing and implementing measures that help manage the adverse effects of climate change (OECD, 2009; Chambwera et al., 2014; Noble et al., 2014).

Adapting to climate change is crucial because even with great efforts to mitigate greenhouse gas emissions, the world is already undergoing climatic changes and will continue to face the consequences (IPCC et al., 2023). As a result, adaptation should begin with a comprehensive understanding of the climate's current and projected changes, including the anomalous variations in precipitation patterns, temperature, sea-level rise, and other climate-related factors that affect different regions (UNEP, 2022; IPCC et al., 2023). Furthermore, vulnerability assessments can be conducted to evaluate the sensitivity and adaptive capacity of systems, communities, and sectors to these climate change impacts (Noble et al., 2014; Atteridge & Remling, 2018). These assessments typically consider factors such as exposure to climate hazards, existing socioeconomic conditions, governance structures, and access to resources and technological advancements (Chambwera et al., 2014; UNEP, 2022). This also helps leverage community-based adaptation practices while strengthening institutional frameworks and governance to better coordinate and scale up adaptation efforts.

As mentioned earlier, vulnerability assessments can also help determine the adaptation goals and needs (Noble et al., 2014). These goals can vary across scales, from national to local governments. Cochrane et al. (2019) perceive vulnerability assessments and adaptation planning as forward-looking and a means to consider likely changes in the future. The "participation by local experts and stakeholders ensures knowledge exchange, local capacity-building, ownership, and outputs rooted in the local realities are accepted as legitimate and reinforce and complement relevant legal frameworks and laws" (Cochrane et al., 2019:2). Micale, Tonkonogy & Mazza (2018) corroborate that adaptation efforts must be directed toward the most vulnerable. Dixit et al. (2022) suggest that adaptation strategies should outline specific actions that reduce exposure to climate risk and enhance resilience. These strategies can include actions related to land-use planning, water management, health systems, agriculture, coastal protection, and others (UNEP, 2021, 2022). The strategies often involve short-term, mid-term, and long-term actions developed through stakeholder engagement and participatory processes (AfDB, 2021; Dixit & O'Connor, 2022).

On the other hand, Smit & Pilifosova (2001) explore the notion that the effectiveness of adaptation will ultimately be measured by the extent to which reduced risk results in improved ecological and human well-being. He gives an example of building adaptive capacity, which reduces vulnerability while increasing responsiveness to the shocks and stresses associated with climate-related hazards (Smit & Pilifosova, 2001). Therefore, having adequate "adaptive capacity should strengthen individuals, communities, and systems' ability to predict, respond, and adapt to climate change impacts" (Smit & Pilifosova, 2001). Some adaptive capacities may include improving access to finance and information, building skills and encouraging knowledge sharing, promoting technology transfer, fostering innovation, or ensuring good governance and institutional coordination (UNEP, 2021, 2022). Such development outcomes would be measured relative to the adaptation baseline of changing climatic conditions and evolving climate hazards (Owen, 2020).

According to Ricci & Mangenot (2023), there is a connection between finance, adaptation, and adaptative capacity. For enhanced adaptive capacity, there is a need for finance which subsequently enables the implementation of adaptation measures. However, evaluating how climate finance impacts adaptation and adaptive capacity, particularly at the national level, remains challenging. Ricci & Mangenot (2023) state that research over the years questioned the impact of adaptation finance programs and found that the areas of vulnerability were neglected over the technical solutions in most international agreements.

Climate change adaptation remains primarily incremental, dynamic, and iterative. Adaptation should involve identifying risk exposure and vulnerable areas, setting ambitious goals, developing strategies and action plans, implementing measures, and continuously learning and adjusting (Dixit et al., 2022; UNEP, 2022). Runhaar et al. (2018) and AfDB (2021) mention that not adapting to future climate change impacts may reinforce vulnerabilities or create new risks, especially for the most vulnerable populations. UNEP (2022) adds that stakeholders' limited involvement in capturing required resources is one of the main reasons for shortcomings in achieving adaptation goals. Guzmán et al. (2022) also mention that the exclusion of marginalized groups, including women, indigenous people, and local communities, has often led to maladaptation.

Furthermore, disregarding the local context and not giving ownership of the adaptation design and implementation to local communities also influences climate change adaptation's financing and overall success (UNEP, 2022). Therefore, it is fundamental that the affected population is involved in any planning as this ensures that there is continuous well-being and enhances the resilience of communities and ecosystems in a changing climate (UNEP, 2021).

2.2 Origins of Nationally Determined Contributions

The origins of (NDCs) can be traced back to the climate negotiations held by the UNFCCC (Fransen et al., 2022). In December 2015, at the Conference of Parties (COP21), a historic international climate change treaty was reached among parties worldwide (Halimanjaya et al., 2021b). Under this agreement, parties publicly outlined intended post-2020 climate actions, known as *Intended Nationally Determined Contributions* (INDCs) (Kissinger et al., 2019). "The Paris Agreement intended for NDCs to be made more ambitious over time, establishing a five-year cycle for countries to submit enhanced commitments" (Fransen et al., 2022:5). After the Paris Agreement, the next cycle would be in 2020/2021, with the next update due in 2025/2026. It is almost a decade since the first submissions of commitments to the Paris Agreement, and roughly 80 percent of NDCs have been updated (Fransen et al., 2022).

Before the Paris Agreement, the Kyoto Protocol was used by countries committing to combating climate change. It established legally binding emission reduction targets for developed countries (UNFCCC, 2020; AfDB, 2021). However, the Kyoto Protocol did not include mitigation commitments for developing countries, as it was grounded on the principle of *"common but differentiated responsibilities (CBDR)",* recognizing that developed countries historically contributed more to greenhouse gas emissions (UNFCCC, 2015:2). However, the Paris Agreement introduced a new approach by emphasizing the need for all countries to participate in addressing climate change, considering their circumstances and capabilities (AfDB, 2019, 2021). In addition, the agreement recognized that each country would determine its contributions towards reducing GHG emissions and adapting to the impacts of climate change(UNFCCC, 2015).

Countries were requested to update their NDCs by 2020 (Fransen et al., 2022). These updates were expected to present the highest possible ambition for each country at that time (Fransen et al., 2019; Dixit et al., 2022). The NDCs were to include information on the country's mitigation targets, adaptation actions, and the support needed for implementation, including finance (Fransen et al., 2019). Developing NDCs would allow countries to define their specific climate goals and outline their plan to achieve them (AfDB, 2021). This approach would acknowledge each country's distinct national circumstances, development priorities, and capabilities (Fransen et al., 2022). At the same time, it encourages countries to enhance their ambition progressively. It also allowed for a more inclusive and participatory approach of all relevant stakeholders, such as the national government, civil society, the private sector, and other relevant stakeholders (Dixit & O'Connor, 2022; Dixit et al., 2022).

Since its inception, the success of the Paris Agreement remains significantly dependent on how ambitious parties commit to combating climate change (Dixit et al., 2022). The more ambitious the pledges, the higher the rate of climate action, which also acts as a barometer of where the world stands in tackling climate change (AfDB, 2019; Fransen et al., 2022). UNFCCC (2020) reiterates that climate goals communicated in these NDCs significantly show whether the long-term goals of the Paris

Agreement will be achieved. These goals include keeping the global temperature below 2°C while limiting the increase to 1.5°C (Mohan, 2022; UNEP, 2022). Furthermore, countries also agreed to a collective goal that promotes adaptation while aligning financial flows with low-emissions and climate-resilient development (UNEP, 2021; Dixit et al., 2022).

As mentioned earlier, the design and formulation of NDCs have largely been shaped by a global agenda centered on emissions reductions (AfDB, 2019). This has historically marginalized adaptation concerns, especially for regions like Africa, where the focus should include building resilience to climate impacts. Dixit et al. (2022) suggest that NDCs were designed to pair national policies with national priorities and capabilities with the global framework. However, Figueres & Pulgar-Vidal (2015) bring forth that the ambiguous phrasing could have muddled parties on whether NDCs were to contain merely future emission reduction targets or could include other goals. Notably the inclusion of climate change adaptation plans and the necessary financial requirements. As a result, some, especially developing countries, present their adaptation plans and finance needs, even though *Article 4 of the Paris Agreement* explicitly states that parties were to prepare and communicate mitigation measures in their NDCs (UNFCCC, 2015; Dixit et al., 2022).

On the other hand, the African Group of Negotiators (AGN) has consistently pushed for greater attention to adaptation needs, as the continent faces disproportionate impacts from climate change. The AGN advocates for adaptation to be given equal weight as mitigation and emissions reduction. This is due to the high vulnerability of African countries to climate impacts and the need for urgent adaptation measures(Simon Chin-Yee, Tobias Dan Nielsen & Lau Øfjord Blaxekjær, 2020; Biesbroek et al., 2022).

According to Fransen et al. (2022), NDCs are country-specific building blocks that build towards collective goals. Conference of Parties 24 (COPs) eventually agreed that parties to the Convention could include an adaptation component in their NDCs submissions (Dixit & O'Connor, 2022; Fransen et al., 2022). This consensus would make specific provisions for the least developed countries and small island developing states – who contribute little to the global emission of greenhouse gases yet are expected to experience some of the worst impacts of climate change (Dixit et al., 2022; Mohan 2022). "For everyone else, a set of guidelines is available on the information countries may include in their NDCs" (UNFCCC, 2020:10). These rules were established to make country pledges comparable to some degree (Figueres & Pulgar-Vidal, 2015; Fransen et al., 2019)*;* a process that ensures that countries' actions are clear, measurable, and verifiable*.*

AfDB (2019) points out that NDCs are a crucial tool for feedback and knowledge sharing between national and international decisions on climate change. For instance, the establishment of the Standing Committee on Finance was to help the COP understand the adaptation needs of developing countries that were reported in national documents. It is imperative that governments comprehensively communicate their national plans. Therefore, NDCs should articulate their commitments, showcase their actions, and track progress towards a sustainable, low-carbon future (AfDB, 2021). Furthermore, Halimanjaya et al. (2021) suggest that considering unique circumstances, countries should describe how they will adapt to climate change impacts and what support they need or can offer other countries. The UNFCCC describes that a well-designed NDC should demonstrate how a country is performing its part in combating climate change and limiting future climate risks (Halimanjaya et al., 2021b).

Fransen et al. (2022) state that in preparing NDCs, countries should have a transparent process that shows accountability with domestic and international stakeholders. In addition, the United Nations recommends that countries be ambitious in setting their targets, especially in carbon-intensive sectors (Halimanjaya et al., 2021b). NDCs should also be trackable to ensure countries can check progress and meet their goals (AFDB, 2013). This also allows each country to contribute a fair share to address climate change, corresponding to their emission levels (Blocher et al., 2022). Moreover, governments should also articulate the integration of climate change into other national priorities, such as poverty reduction, which can signal to stakeholders how to contribute to these efforts (AfDB, 2019).

Lastly, the UN clarifies that nationally determined contributions are non-binding national plans that the parties can establish independently (UNFCCC, 2015). Furthermore, under the UNFCCC, NDCs are the first mechanisms for defining greenhouse gas targets that apply equally to developed and developing countries (Mohan, 2022). According to AfDB (2019), formulating NDCs combines a top-down system of a formal international agreement with a bottom-up approach where countries come up with their targets and policies. However, "there is a binding iterative catalytic framework designed to boost climate action over time" (ROGER, 2021:2). Once countries have set their initial NDCs, these will be updated on a 5-year cycle (AfDB, 2019).

In addition to submitting nationally determined goals, Article 13 of the Paris Agreement states that "developing country Parties should provide information on financial, technology transfer and capacity building support needed and received" (UNFCCC, 2020). However, estimating financial needs has been challenging for most developing countries due to a lack of technical capacity (Guzmán et al., 2022). In addition, the absence of guidelines results in countries employing varying levels of detail and different methodologies to identify their climate finance needs (AfDB, 2021; Halimanjaya et al., 2021a). Inconsistencies and inadequate information provision were other challenges in closing the gap between what was received and what was needed (Blocher et al., 2022; Meattle et al., 2022).

2.3 Climate Change Adaptation Component in Nationally Determined Contributions

The adaptation component in Nationally Determined Contributions (NDCs) refers to the segment that outlines a country's strategies, actions, and priorities for adapting to the impacts of climate change (AfDB, 2019). By explicitly outlining adaptation interventions, countries signal their intent to prioritize adaptation alongside mitigation efforts and contribute to the global response to climate change (OECD, 2009; Dixit et al., 2022). The component also addresses adaptation finance needs, including financial gaps, potential sources of financing, and how to access those funds (Buchner et al., 2021; Guzmán et al., 2022). Guzmán et al. (2022) add that some countries also choose to disclose the disbursement of funds obtained and promote partnerships for adaptation financing.

According to AfDB (2019) and Dixit et al. (2022), including an adaptation component in NDCs echoes the recognition of the need to tackle the vulnerabilities and risks posed by climate change and enhance the resilience of human beings and ecosystems. In its infancy, NDCs were exclusively viewed as a tool for documenting mitigation targets (Figueres & Pulgar-Vidal, 2015). However, most developing countries persisted in having a clear global adaptation goal as part of the Paris Agreement (AfDB, 2021). It is reported that African countries eagerly encouraged adaptation actions to become part of NDCs. In the first round of NDC updates to support this initiative, approximately 90 percent of African

countries demonstrated a clear commitment to adaptation by outlining intended actions in their NDCs (AfDB, 2021).

African governments also pointed out the significance of the design and delivery of adaptation in NDCs (AfDB., 2019). They asserted that the inclusion would enable countries to understand their climate risks better, improve their response to these risks, and account for their adaptation actions under the UNFCCC (Dixit et al., 2022). Circumstances in Africa provided a notable link between adaptation and mitigation, mainly how delays or failed mitigation can result in the need for more adaptation measures (Guzmán et al., 2022). On the other hand, poorly designed adaptation measures could also result in trade-offs with adverse climate change impacts (Magnan et al., 2016). Therefore, addressing the two in NDCs enhances the resilience and capacities of countries in combating climate change (AFDB, 2013; Fransen et al., 2019).

Research findings have revealed that including adaptation in the NDCs has improved adaptation communications from developing countries (AfDB, 2019; Dixit & O'Connor, 2022). It has also created the opportunity to identify and establish standard metrics for assessing adaptation measures (AfDB, 2019). AfDB (2019) states that having the adaptation component also enables developing countries to adopt a blueprint from other party countries—thus promoting learning and knowledge sharing, especially for determining adaptation financial needs.

UNEP reports that most developing countries now engage adaptation planning instruments that define objectives, determine time frames, and strengthen the science base to present their financial needs in NDCs better. Taking this approach ensures that implementing NDCs or NAPs is effective (UNEP, 2022). With quantified adaptation targets based on process-related outputs, NDCs shift towards an "outcome-oriented and measurable adaptation planning tool" (UNEP, 2021).

In the case of African countries, AFDB found that their NDCs primarily disclose current and short-term adaptation goals, needs, and priorities (AfDB, 2019, 2021). Which has been valuable in disclosing the financial and non-financial costs of adaptation and enhancing the mobilization and scaling up of resources within and outside the UNFCCC context. Nevertheless, limited knowledge and information gaps at national and regional levels remain a key challenge for articulating adaptation measures in NDCs, especially in Africa (AfDB, 2019).

Finally, having the adaptation component in NDCs creates an opportunity to present information on the institutional arrangements and coordination mechanisms for implementation (Fransen et al., 2022). Guzmán et al. (2022) state that describing the roles and responsibilities of stakeholders and the coordination with relevant sectors at different levels of government provides accountability and transparency. For this reason, African parties believed climate change adaptation should be equally considered in designing and delivering NDCs (AfDB, 2021).

The following section ties all the previous sections into '*climate change adaptation finance needs'* communicated in NDCs. A report by the AfDB provides a snapshot review of the African NDC adaptation component detailing the financial needs and reporting gaps (AfDB, 2019). The findings indicated remarkable variations in the presentation of each country's adaptation component and financial needs (AfDB, 2019). AfDB report shows that "the content varied in length, depth, method, and scope… section structure and quality", which potentially influenced the cost estimations provided

in NDCs (AfDB, 2019:9). Therefore, the following section is the backdrop of adaption finance needs in NDCs.

2.4 Climate Change Adaptation Finance Needs in NDCs

In simple terms, " *'adaptation needs'* refer to specific requirements and measures necessary to address climate change impacts and increase resilience to its effects" (AfDB, 2021:5). These needs arise from recognizing that climate change is already occurring and will continue to intensify, posing risks and challenges to various sectors, ecosystems, and communities (Noble et al., 2014; Halimanjaya et al., 2021a). However, while it is acknowledged that identifying adaptation needs is integral to addressing climate change, the Convention does not formally define *adaptation needs* or its scope (Halimanjaya et al., 2021a). Guzmán et al. (2022) also point out that even though the term '*adaptation needs'* is frequently found in the climate change literature and policy documents, there is still no universal definition—which often sparks debates on what qualifies as an adaptation need (Micale, Tonkonogy & Mazza, 2018).

On the other hand, Noble et al. (2014) discovered that even though a universal definition is lacking, the most common description found in climate change literature is in the sense of urgency and immediate needs resulting from the adverse impacts of climate change. For example, Working Group II (WGII) of the IPCC describes adaptation needs as "the gap between what might happen as the climate changes and what we would desire to happen, including the actions and resources needed to address that gap" (Noble et al., 2014:4). WGII adds that adaptation needs must also include the financial needs or costs of adaptation (Noble et al., 2014). *Article 4 of the Convention* captures the term as "specific needs and concerns of developing country Parties arising from the adverse effects of climate change" (UNFCCC, 2015:6).

Although authors and policymakers describe adaptation needs in various ways, all definitions involve addressing climate risks and taking up opportunities that arise from climate change (OECD, 2009; AfDB, 2021; UNFCCC, 2022b). WGII suggests that adaptation needs become more apparent when expected climate risks or experienced climate impacts require immediate action to ensure the safety and security of populations, assets, and ecosystems (Noble et al., 2014). This means that the scope of adaptation needs will continue to expand. In such instances, a hazard-based approach focusing on the drivers of climate impacts can be employed when discussing significant vulnerabilities and adaptation activities in response to sudden climate risks (Chambwera et al., 2014). More recently, Halimanjaya et al. (2021b) pointed out that the focus should shift to the underlying causes of these vulnerabilities, such as capacity, institutional, informational, and financial needs, to achieve effective measures.

Dixit & O'Connor (2022) argue that adaptation needs are specific and constantly change depending on different stakeholders' perceptions of policies or trade-offs. Meanwhile, Noble et al. (2014) demonstrate that these needs will evolve as underlying vulnerability drivers and other factors change. For example, an increase in climate risk or the discovery of new adaptation options will influence the needs of those affected by climate change (Prabhakar, Srinivasan & Shaw, 2009; Noble et al., 2014). On the contrary, the UNFCCC found that identifying adaptation needs was no longer a starting point but a step in every stage of the adaptation cycle (UNFCCC, 2022b). This cycle would involve vulnerability assessments, analysis of adaptation options, planning and implementing adaptation

options, and monitoring and evaluating adaptation actions requiring adequate financial resources (Blocher et al., 2022; Guzmán et al., 2022). Thus, it is undeniable that climate finance is fundamental to each stage of the adaptation process. Therefore, it requires a coherent and well-coordinated distribution of funds (UNFCCC, 2020).

To achieve the above, a Standing Committee on Finance (SCF) was established to assist with any financial mechanisms related to the Convention and Paris Agreement (UNFCCC, 2020). In addition, the SCF would measure, report, and verify the financial support provided to developing countries. Furthermore, at the Conference of Parties 24, it was decided that every four years, there should be a report on determining the needs of developing countries relating to implementing the Paris Agreement (NDR) (Halimanjaya et al., 2021a). This NDR report would define the gap between the financing required for adaptation and that available to developing countries—better known as the *adaptation finance need* (Guzmán et al., 2022).

The NDR would underline qualitative information, known as the *needs,* and quantitative information, which would be the *costed needs* (UNFCCC, 2020). The costed needs are either at the project level or from economic modeling (UNFCCC, 2020). This information would be extracted from national priorities and plans in reports submitted by each country to the UNFCCC. Determining the costed needs would help identify the financing gaps and ways to leverage both public and private finance (Savvidou et al., 2021; Guzmán et al., 2022). Nationally Determined Contributions often highlight this gap between the required adaptation finance and the available financial resources, hence its relevance in the adaptation process (Fransen et al., 2022).

Guzmán et al. (2022) state that this gap represents the difference between the estimated costs of adaptation measures and the current funding sources, including domestic budgets, international climate finance, and private sector investments. Therefore, the adaptation component in Nationally Determined Contributions (NDCs) should aim to define this financial gap to successfully implement the adaptation actions (Dixit et al., 2022; Guzmán et al., 2022). Considering this, the AFDB reiterates that NDCs are one of the best tools for reporting adaptation finance needs because they could also identify priority areas for adaptation investment (AfDB, 2019, 2021). This helps ensure that limited adaptation finance is directed towards the most vulnerable and that the available resources are optimised (Guzmán et al., 2022).

Mohan (2022) suggests that a cost estimation is the best method to determine cost needs. The process involves assessing and analyzing the costs associated with specific adaptation interventions, such as infrastructure upgrades, ecosystem restoration, capacity building, and community-based adaptation projects (Mekonnen, 2014; Blocher et al., 2022). By addressing climate change adaptation finance needs in NDCs, countries can articulate their financial requirements, prioritize actions, and attract the necessary resources to implement adaptation measures (Dixit et al., 2022). Dixit & O'Connor (2022) also note that countries can strengthen resilience, reduce vulnerabilities, and enhance adaptive capacity in the face of climate change, ultimately contributing to sustainable development and achieving climate goals.

Nonetheless, Kotz, Levermann & Wenz, (2024) argue that several issues challenge the effective allocation and transparency of adaptation finance, including the difficulty in distinguishing adaptation costs from general development finance, variability in cost estimation methodologies, and

inconsistent reporting frameworks across countries. For instance, some countries categorize their own climate-related contributions as unconditional, while others consider them conditional on international assistance. They suggest that aligning financial frameworks and promoting innovative financing mechanisms could help attract adaptation funding, balancing climate and developmental goals. Overall, the findings underscore the importance of standardized methods for calculating climate costs and the role of developed nations in providing both technical and financial support to meet global climate commitments.

2.5 Processes, Methodologies, and Underlying Assumptions Used in Cost Estimating Adaptation Needs

In climate change literature, minimal attention is given to categorizing methodologies for estimating adaptation finance needs; instead, researchers and policymakers focus more on describing the methods and tools used in an adaptation process (Singh et al., 2020). Nevertheless, all adaptation processes have methodologies (UNFCCC, 2022b). According to UNFCCC (2022), most national documents omit the typology for methodologies; instead, they list the methodologies without providing detailed descriptions. The AfDB (2019) indicated that most developing countries have yet to establish a process for classifying and synthesizing methodologies for assessing their adaptation needs.

Singh et al. (2020:16) indicate that "establishing a systematic typology may assist in further understanding the methodologies being employed, as well as their relative strengths and weaknesses". UNFCCC (2022) states that methodologies for adaptation needs assessment are frequently classified as either top-down or bottom-up. Top-down is impact-driven and uses climate models to determine the impacts of climate change to be adapted to, while bottom-up is vulnerability-driven and focuses on the current vulnerabilities to determine the adaptation needs (Savvidou et al., 2021; UNFCCC, 2022b). UNFCCC (2022) notes that the former relies primarily on quantitative and modeling methods. A top-down approach commonly emphasizes economic needs and usually uses integrated assessment models (IAM) for cost-estimating adaptation needs at a national level (Mekonnen, 2014). Qualitative methods are essentially for capturing the community-level adaptation costs that focus on social adaptation needs (Dixit & O'Connor, 2022). UNFCCC (2022) also reports that adaptation needs have evolved so much that hybrid approaches are more reliable in ensuring the accuracy of cost estimations.

On the other hand, the UNFCCC argues that a methodology established by the IPCC has been instrumental in advancing knowledge on adaptation (UNFCCC, 2022b). The methodology has been evolving over three decades with the help of experts assessing and improving prior knowledge (UNFCCC, 2022b). Generally, the methodology incorporates a new analysis of the old findings. The process "examines the probability and magnitude of climate change impacts, investigates when the impacts will be evident and when the adaptation measures need to be in place and documents the level of confidence for all" (UNFCCC, 2022:16). According to the UNFCCC, following this methodology has increased the recognition of Indigenous knowledge as a crucial tool for assessing adaptation needs. Nevertheless, most developing countries have resorted to impact-based, vulnerability-based, and risk-based approaches for national estimates of adaptation needs (Guzmán et al., 2022). Similarly, the Standing Committee on Finance used the same approach for the first NDR (UNFCCC, 2020).

Dixit & O'Connor (2022) argue that these processes and methodologies still fail to fully address the scope of adaptation needs. For example, some countries list the methodologies used to estimate costs and financial needs but without providing detailed information on those methodologies (Dixit et al., 2022). In other instances, countries could not provide any cost estimates for their adaptation needs, which has increased the information gap on adaptation finance needs (Guzmán et al., 2022). Dixit & O'Connor (2022) further states that the challenges of quantifying adaptation finance needs must be fully acknowledged. UNFCCC (2020) recognizes the shortcomings but discloses that the few methodologies designed to estimate adaptation costs and needs can still be employed successfully.

In the context of African NDCs, AfDB (2021) acknowledges the inconsistencies in the methodologies used for adaptation cost estimations and financial needs. Guzmán et al. (2022:12) argue that "the inconsistencies are attributable to no mandate on the presentation of information on adaptation finance needs, with no guidelines on assessment methodologies or reporting formats". Since most African countries failed to disclose the methods used to determine their financial needs, Guzmán et al. (2022) broadly classified them into two categories—goal-based and project-list methods. The Guzmán et al. (2022:12) case study on African NDCs found that; "out of 53 African NDCs, 27 countries used a goal-based estimation method, 17 used a project-list method, and two countries used both approaches". A few countries could not be allocated to either of the methods as they had limited information on the figures presented in their NDCs (AfDB, 2019; Guzmán et al., 2022).

According to Guzmán et al. (2022), the costs are derived from global values and modelled scenarios under the goal-based estimation method. The method follows a top-down approach using proxy values to compare the information at a national level (Guzmán et al., 2022). For example, the starting point is identifying an adaptation objective under different economic scenarios and estimating the probable cost of meeting that goal. Depending on the assumptions, these costs are usually disaggregated by sector (AfDB, 2021; Guzmán et al., 2022). On the other hand, a project-list estimation method gathers data from the bottom up, allocating costs to each project in the given time frame (Guzmán et al., 2022).

Cost-benefit analysis (CBA) is one of the methods used to prioritize projects when using a project-list estimation method (Mekonnen, 2014). Also, specific guidelines and tools can be employed for a more precise evaluation depending on the sector under assessment. For instance, FAO provides the Ex-Ante Carbon-balance tool (EX-ACT) to conduct environmental assessments for the AFOLU sector (UNFCCC, 2022b). Eventually, all individual project costs are totalled to present the overall financial need (Guzmán et al., 2022). Guzmán et al. (2022) note that using the goal-based method only provides general estimations, while the latter can provide more granular information on the specifics of the entire process. However, Fransen et al. (2022) state that both methodologies offer valuable insights when well-defined.

Furthermore, it has been concluded that the two approaches to estimating costs are not mutually exclusive (Guzmán et al., 2022). Therefore, a mixed approach might help describe the actual costs and verify the adaptation finance needs (AfDB, 2021). Alternatively, top-down gives ballpark estimates of total adaptation costs but is highly uncertain. At the same time, project-based provides detail on what

is currently planned, but this is unlikely to be all required. So, it may give reasonable estimates of immediate needs.

Besides the methodology used in determining adaptation needs, countries had different timelines within the same report (AfDB, 2019; UNFCCC, 2020). Guzmán et al. (2022) reported that most African countries used a ten-year lead time from 2020 to 2030. Some covered the 15-to-30-year range of their financial needs. However, not all countries specify the time range for all their adaptation needs, as presented in NDCs (Fransen et al., 2022; Guzmán et al., 2022). It is evident that these inconsistencies in processes, methodologies, and underlying assumptions when cost estimating financial needs affect the quality of cost information presented (AfDB, 2021; UNFCCC, 2022b). The following section will discuss further the gaps related to this subject.

2.6 Drawbacks and Suggestions on Cost Estimating Adaptation Needs for NDC Implementation

The most reported drawback is the lack of a standard reporting format on adaptation finance needs (AfDB, 2021; Guzmán et al., 2022). This has created comparability and completeness issues in reports submitted to the UNFCCC (Halimanjaya et al., 2021a). According to AfDB (2021), standardizing factors such as the time frame to be covered when reporting finance needs can help to curb the incomparability of reports and better present the finance gap. AfDB (2019) suggests that more research be conducted for a standard methodology for reporting financial needs. This would allow for comparable estimates and data reported in NDCs. Further studies on the subject can be directed toward sub-national and local levels to identify more robust approaches and practices to enhance understanding of costing adaptation actions (Fransen et al., 2022).

Biesbroek et al., (2022) explore significant barriers in climate adaptation planning, particularly emphasizing the challenges in linking cost assessments with actionable frameworks. Their main findings highlight that institutional and governance issues, such as fragmented decision-making, inadequate regulatory frameworks, and lack of interagency collaboration, are major obstacles to effectively implementing adaptation strategies. Additionally, the research found that limitations in data standardization and financial accountability hinder the reliability of cost assessments, making it difficult for countries, especially developing ones, to project accurate adaptation costs and secure the necessary funding.

Biesbroek et al., (2022) argue for a holistic approach to overcome these barriers, which includes enhancing policy coherence, fostering partnerships across sectors, and improving local governance capacities. By contextualizing adaptation planning within these broader governance challenges, (Biesbroek et al., 2022) provide insights into why standardized, actionable frameworks are critical for developing nations to manage climate adaptation effectively. This study contributes valuable context for understanding how institutional capacity building and streamlined cost methodologies could aid these countries in securing and utilizing adaptation funds more efficiently.

Studies have also found that available data on cost estimations of adaptation needs contain many inconsistencies. Notable variations are seen in the categorization of adaptation activities, especially in cases where multiple data sources submitted by one country or party are not uniform (Halimanjaya et al., 2021a; UNFCCC, 2022b). Guzmán et al. (2022) highlighted that such reports pose a high risk of

double-counting cost estimates. For example, an estimate is given in one report as a sectoral cost, while another report presents it under a project cost (Guzmán et al., 2022). Guzmán et al. (2022) suggest incorporating all information in other national planning documents to avoid double counting financial needs. Adaptation finance needs can also be underestimated when countries do not include them in national communications, such as the NDCs.

Another drawback relates to data coverage on costed needs; this has been a significant challenge for adaptation (Halimanjaya et al., 2021a). There is a knowledge gap on the effectiveness of processes adopted to estimate costs, current interventions, and adaptation funding–which considerably restricts the appraisal of future adaptation benefits and trade-offs (Singh et al., 2020; UNFCCC, 2022b). Blocher et al. (2022) and Meattle et al. (2022) propose further scientific research on related topics, such as residual risks and maladaptation, to help close the knowledge gap. This would also require reporting on the degree of data collection coordination at a global scale. On the other hand, the absence of granular data, especially at the sector and sub-sector level, limits understanding of the cost estimates reported (Guzmán et al., 2022).

AfDB (2021) reiterates that most developing countries do not reference the processes for estimating adaptation finance needs in their national reports or communications, such as the NDCs. Guzmán et al. (2022) note that if the underlying assumptions of the methodology used are not stated, this could lead to misinterpretation of the data provided. The lack of clear objectives for each adaptation instrument could also result in the same information being repeated across different instruments (AfDB, 2021). Kotz, Levermann & Wenz, (2024) suggest developing a uniform methodology for calculating climate costs based on best practices (such as those outlined by the IPCC or the UNFCCC) would help mitigate discrepancies. This could include standardized guidelines for calculating adaptation versus development finance and establishing a consistent timeframe for cost estimations.

Blocher et al. (2022) point out that many countries do not mention the calculation methods used, which limits the availability of information on costs. He adds that references to the integration of climate change adaptation into national budgets are also limited (Blocher et al., 2022). Consequently, “more work needs to be done to develop costing methodologies and align them with other ongoing initiatives to integrate climate change risks into their national budgets to develop robust cost estimates” (AfDB, 2021). Lastly, having “comprehensive disaggregated data will provide a fuller picture of the needs and how these are split across various sectors; this is vital to understand financing gaps and allocate funding more effectively properly” (Guzmán et al., 2022).

The literature review revealed that understanding adaptation finance needs relies heavily on the quality of the data obtainable, especially for the finance providers (Buchner et al., 2021; Meattle et al., 2022). As mentioned earlier, the challenges involve definitions, methodologies, accounting issues, lack of universal metrics, and so forth (AfDB, 2021; Guzmán et al., 2022). This has resulted in low data reliability and widened the adaptation finance gap. UNEP (2022) has also reported that substantial overestimations of financial flows have been reported due to a lack of quality controls on reporting through NDCs or other official channels. For instance, some countries identify needs, investments, or costs without explaining the scope of actions planned. Fransen et al. (2019) argue that “including finance in an NDC is voluntary and many countries do not include it, but this cannot be interpreted as

an indication that they have no climate finance requirements". Therefore, many reports do not fully reflect the financial needs of countries.

Most importantly, as mentioned earlier, there remains little to no consensus on what qualifies as adaptation finance or how it should be measured (UNFCCC, 2020). Adaptation activities are deemed highly context-specific as they depend on particular climate change signals and the climate vulnerability of the population or region (UNFCCC, 2022b). This differs from climate migration activities that can be simply qualified by the nature of the project or activity (Halimanjaya et al., 2021a; Fransen et al., 2022). Micale, Tonkonogy & Mazza (2018:8) state, "It is difficult to distinguish between a standard development project and a development project that contributes to climate change adaptation". This has resulted in countries taking different approaches and methods for tracking and reporting adaptation finance.

Finally, cost estimations for adaptation are crucial to implementing NDCs (Dixit et al., 2022; Mohan, 2022). If countries exhibit how their financial needs relate to their targets, it can help obtain financial support (Cassim et al., 2020; Guzmán et al., 2022; Meattle et al., 2022). By providing estimates, it helps potential funders to understand their financial needs. When the methodology and assumptions applied to these estimates are also provided, it increases the chances of receiving international aid (AfDB, 2021). Mohan (2022) suggests that countries may alternatively include a plan or intention in the NDCs to undertake an in-depth analysis and assessment of the estimation of financial needs.

2.7 Summary

The state of research on adaptation finance needs in NDCs has been explored, and the placement of this thesis in the dialogue with the existing literature. While adaptation finance needs have received attention in the climate change industry, research on determining financial needs is still limited. Not many studies explore the different methodologies and processes that can be utilized to establish costs and needs. Many papers have resorted to aggregating the costs based on GDP or regional level without considering each country's underlying assumptions or context (AfDB, 2019; Guzmán et al., 2022).

From the few relevant studies on the adaptation component in NDCs, the review found that the '*State of the Nationally Determined Contributions: Enhancing Adaptation Ambition'* by Dixit et al. (2022) only focused on how countries could become more ambitious in setting their adaptation targets. The working paper compares the first and updated NDCs of 86 countries, analyzing changes in their adaptation components. Dixit et al. (2022:1) analysis highlights the need for "improved guidance on including adaptation in the NDCs, increased clarity about the goals and objectives of countries' adaptation components, and support for investment and implementation plans for prioritized adaptation actions".

The assessment conducted by Dixit builds on the past World Resources Institute (WRI) work on NDC enhancement. Similarly, this research applies the same framework to assess how much a country's NDC meets the WRI principles on adaptation reporting, particularly their financial needs. However, Dixit's paper does not determine how well a country reports its adaptation component in NDC, an element this paper attempts to achieve. Furthermore, this paper seeks to identify the methods and processes and their robustness in determining adaptation finance needs.

The paper by Guzmán et al. (2022) amplifies the importance of determining climate financial needs, especially in developing countries. The report suggests that identifying financing gaps and opportunities helps guide stakeholders to access, allocate, and mobilize climate finance effectively. Furthermore, they argue that estimating needs also helps assess the effectiveness of climate finance flows. However, this paper looks at adaptation and mitigation financing, which often aggregates the costs and needs of combating climate change. African NDCs are reviewed in this paper, and a combined cost between 2020 and 2030 is established for implementing climate action. The report also looks at the total climate costs and needs by sector across the regions of Africa. Here, the research found a gap in the findings of adaptation finance analyses by country.

Furthermore, Guzmán et al. (2022) suggest that although African regions show substantial financial needs, these could fall short of the actual costs due to a lack of capacity and data to make accurate assessments. Hence, this research intends to assess the robustness of processes in determining these financial needs. Guzmán et al. (2022) also look at the methodological approaches to assess climate finance needs, such as the estimation method (top-down) and project-list method (bottom-up). Overall, the paper only attempts to group methodologies African countries adopt in their NDCs. The report bases its classification on how needs are estimated and how information is collected and presented.

Considering the above findings, it is undeniable that there is a need to assess the adaptation component in NDCs. It is crucial for the component to be concise and have robust processes and methods that reflect the accurate financial needs of countries. While African countries expressed high adaptation financial needs in their NDCs, these could be underestimated.

Chapter 3: Research Methodology

This chapter describes the methodological approach followed in this research. It outlines the rationale behind the selection of the countries assessed and then describes the data collection and analysis methods. It also provides the framing of the research findings, which are crucial in achieving the purpose of this study. As mentioned in the earlier chapters, the research's main objective is to assess the robustness of processes used to determine adaptation finance needs presented in Nationally Determined Contributions (NDCs). Finally, the chapter highlights limitations that potentially influenced the research outcome.

3.1 Research Methods

Across the globe, countries continue to experience more abrupt climate-related disasters, making it crucial to have robust financing processes that enhance the response to climate risks (Guzmán et al., 2022). Studies established that developing countries rely more on external financial support to tackle climate change (Meattle et al., 2022). In the last decade, the UNFCCC has reported an increasing need for adaptation finance, mainly communicated through national documents such as NDCs and NAPs (UNFCCC, 2020). Even though there was an increase in reporting of financial needs, UNFCCC asserts that adaptation finance needs are possibly underestimated due to the complex nature of estimating adaptation costs (UNFCCC, 2022a).

A significant amount of academic and grey literature tally the costs to adapt without assessing the effectiveness of the costing methods and processes used to estimate given figures (AfDB, 2021; Guzmán et al., 2022). Overlooking these processes has resulted in large discrepancies between budgeted and actual costs–further slowing the implementation of adaptation measures. This research aims to close the gap by comprehensively assessing the methodologies and processes used to estimate adaptation finance needs in NDCs. The research highlights the importance of accuracy in costing, financial allocation transparency, and the efficacy of costing methods.

The research adopts a comparative analysis method which provides a holistic view of the processes found in NDCs while simultaneously achieving the research aims mentioned above (Nedeljkovic, Jurenic & Djokic, 2023). National Adaptation Plans (NAPs) were left out of the research as more NDCs indicated their adaptation cost estimates and financial needs, which widened the scope of the research (AfDB, 2021). NDCs also enabled a regional comparative analysis from which meaningful conclusions could be drawn between the two national documents.

In addition, Moradi-Joo et al. (2022) highlight that comparative studies are well-suited for investigating differences and similarities between multiple parties. In this instance, the various processes African countries use to estimate the financial resources required for climate change adaptation. A comparative analysis also enables the identification of complex relationships and interactions that might not be apparent through traditional statistical methods (UNFCCC, 2022a). It also builds an understanding of how different combinations of conditions can lead to specific outcomes, such as the effectiveness of processes used to determine adaptation finance needs (Aerts, 2018).

Overall, the research approach focused on the qualitative nature of the analysis—which involved exploring key factors influencing the calculation processes (UNFCCC, 2022a). The research intended to provide valuable insights that inform better practices and decision-making in adaptation assessment processes. Lastly, conducting a comparative analysis simplified the identification of the basis for cost estimations, or lack thereof (Nedeljkovic, Jurenic & Djokic, 2023).

The following sections elaborate on the steps of the comparative analysis. These steps include country selection, defining key factors and outcomes, data collection, and data analysis. Finally, an analytical framework adopted from the World Resource Institute (WRI): State of the Nationally Determined Contributions: *Enhancing Adaptation Ambition* is introduced to assess the robustness of these processes.

3.2 The Rationale for Country Selection and Assessment Framework

The geographical focus area of this research is Africa (Figure 1). This region was selected because nearly all African countries are classified as developing countries, with over seventy percent listed as the least developed in the world (AfDB, 2021; Guzmán et al., 2022). The continent is also regarded as the poorest among the other continents and in dire need of financial aid in all aspects. According to Halimanjaya et al. (2021), developing countries, particularly African countries, have existing development challenges that exacerbate climate change impacts. Furthermore, Markandya Aniland González-Eguino, (2019) underlines the inability of developing countries to fully address difficulties other than climate change on their own, which indicates a need for external financial support.

AfDB (2019) points out that "emphasizing the challenges associated with the availability of climate finance, and how climate finance is defined, will be worsened if the adaptation components in African NDCs lack rigor in terms of costing, methodology, financing options and implications for national sustainable development". To assist developing countries in reaching their goals related to the Paris Agreement, the UNFCCC COP placed a mandate on the Standing Committee on Finance (SCF) to produce a report on developing countries' needs, especially financial ones (UNFCCC, 2020). The SCF would gather the financial data from national reports such as the Nationally Determined Contributions (NDCs)–making them vital to the development of the NDR.

Before the 2020 NDCs submission deadline, the UNFCCC encouraged developing countries to state their financial needs for implementing the Paris Agreement (Fransen et al., 2019). UNFCCC also requested that the countries provide sufficient detail of their financial needs to ensure that international support is channelled where it is most effective (AfDB, 2019). This meant that developing countries needed to develop processes that enabled them to access international finance from several sources, including NDC partnerships (UNEP, 2021). However, the lack of a standardized reporting format meant that information coverage varied between countries, with some merely listing processes without providing the methodology or context of their costing methods–information highly sought by potential funders (Guzmán et al., 2022).

Figure 1: Countries under study

Source: Author

As mentioned above, this research seeks to close the information gap by assessing the processes followed by developing countries as they determine their adaptation finance needs. Findings from such an assessment can help other countries improve their reporting methods, which contributes to the state of the climate finance landscape of the region and enhance the success of the Standing Committee on Finance (SCF) in producing a report on needs assessment (AfDB, 2021; Guzmán et al., 2022). While African countries are in dire need of external financial support to implement their NDCs, it is also true that they lack the capacity to establish those financial needs. According to the AfDB, (2021), only a few countries have comprehensively expressed their adaptation finance needs. Hence, the research aims to discuss the countries with sound processes that can become blueprints for other developing countries when determining their financial needs.

Prior studies that analyzed African NDCs mainly focused on specific sectors and regions, for example, "Stories Behind the Adaptation Commitments in the Nationally Determined Contributions of Cambodia, Rwanda, Colombia, and Fiji" by Dixit & O'Connor (2022)**.** This indicates a gap in research that requires a further analysis of the adaptation component in NDCs and any associated costs (Guzmán et al., 2022). Furthermore, understanding the costs of adaptation, such as the current expenditures and the sources of such funds, as well as the non-financial costs, increases the chances for external financial support. It also opens the discussions about focus areas, particularly for mobilizing support to scale up adaptation and achieve sustainable development in Africa (UNFCCC, 2020; AfDB, 2021).

In addition to Africa having more developing countries needing financial aid, over 90 percent of the countries have submitted a new or updated NDC, which all contain an adaptation component citing action plans and support requirements (UNFCCC, 2022c). This also influenced the selection of this

region over others, as Africa provides a broad scope for the research. Also, several African NDCs clearly present the adaptation component with the cost implications, which yields a better understanding of the impact of climate change on various sectors in Africa (AfDB, 2019, 2021).

3.2.1 Alternative Assessment Frameworks

Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs), Regional and Continental Adaptation Initiatives, and Climate Risk Insurance and Innovative Financing Models serve as valuable assessment frameworks for understanding and financing climate adaptation in African countries (Trisos et al., 2022). These frameworks allow African nations to articulate, coordinate, and secure financial resources for climate resilience based on their unique vulnerabilities and goals (Biesbroek et al., 2022; Kotz, Levermann & Wenz, 2024). Trisos et al., (2022) explain how each plays a role in building legal frameworks for climate resilience and adaptation across Africa.

NDCs are presented as commitments aligned with the Paris Agreement, specifying each country's climate adaptation and mitigation goals. NDCs are limited in detail for actionable plans and often outline high-level, economy-wide priorities and sectoral goals, but they establish the need for external support and funding, signaling international alignment. However, NDCs lack the implementation framework that NAPs or regional initiatives can provide. Whereas, NAPs, as described in Trisos et al., (2022) offer more comprehensive and actionable frameworks for climate adaptation, enabling countries to create detailed and implementable plans.

Unlike NDCs, NAPs are iterative and often updated to include emerging climate data, providing a roadmap for integrating adaptation into national policies. NAPs emphasize multi-sectoral planning and detail sector-specific adaptation needs, filling in the gap left by NDCs by creating an actionable, policy-aligned adaptation framework (Berrang-Ford et al., 2019; Biesbroek et al., 2022). Trisos et al., (2022) highlight that regional and continental initiatives, such as the *African Union's Agenda 2063* and the *African Adaptation Initiative,* facilitate adaptation efforts across African nations by sharing resources and aligning national strategies with continental goals. These initiatives are essential in addressing climate impacts that transcend borders, such as droughts or transboundary water management issues. They support both NDCs and NAPs by offering a cooperative framework to pool resources, standardize data, and mobilize financing across regions, which is vital given the shared climate vulnerabilities in Africa (Trisos et al., 2022).

Finally, climate risk insurance and innovative financing can be considered critical for addressing adaptation financing gaps. These models, such as resilience bonds and climate insurance schemes, allow countries to manage the financial risk of extreme weather events and attract private investment into adaptation (Berrang-Ford et al., 2019; Trisos et al., 2022). By focusing on financial resilience, these tools support NDCs and NAPs by providing the financial stability and resources necessary to implement adaptation actions effectively, even when climate impacts escalate unexpectedly.

In conclusion, while NDCs often lack the granularity found in National Adaptation Plans (NAPs), their international recognition, comprehensive scope, and structured approach make them powerful tools for identifying and securing adaptation finance for African countries, positioning these nations to meet

their adaptation goals more effectively. In addition, more African countries have submitted their NDCs as compared to other national communications documents (Biesbroek et al., 2022; Trisos et al., 2022).

3.3 Data Collection and Data Analysis

The research compares adaptation costing processes found in NDCs submitted to the UNFCCC. The research is desktop-based and uses secondary data from the NDC registry–a reliable database that provides verified original copies submitted by each country. Additional supporting information from other national documents, such as the National Adaptation Plans (NAP) referenced in NDCs, were excluded because a few African countries produced these other documents, making them incomparable (UNFCCC, 2020, 2022a).

The study population focused on African countries, excluding Libya, which had not submitted its NDC at the time of the research (UNFCCC, 2022c). Limitations such as language barriers and availability of time and resources led to a multi-tiered screening process to select the countries included in this research. The screening process also considered the year in which the NDC was submitted to the UNFCCC. The year 2020 was pivotal for NDCs, as it marked the fifth year since the inception of the Paris Agreement, which required an update or submission by all countries that signed the Paris Agreement (UNFCCC, 2015). However, due to the COVID-19 pandemic, not all countries could meet the deadline, hence the date extension up to 2022 to ensure an exhaustive sample selection.

Therefore, countries were screened and included for text review if they fulfilled the following criteria: (1) Submitted in English or provided an English version, (2) Submitted for the 2020 NDC first update. The screening of African NDCs resulted in 26 countries being excluded from the study and 27 countries selected for the analysis. The table below presents the selected countries, indicating the type of submission, language, and submission year.

Table 1: Selected African NDCs for comparative study

Source: UNFCCC, (2022b)

Country	First Submission/Update	Language	Version	Submission Year
Angola	First Updated NDC	English	2	2021
Cabo Verde	First Updated NDC	English	2	2021
Egypt	First Updated NDC	English	2	2022
Eswatini	First Updated NDC	English	2	2021
Ethiopia	First Updated NDC	English	2	2021
The Gambia	Second Updated NDC	English	2	2021
Ghana	First Updated NDC	English	2	2021
Guinea-Bissau	First Updated NDC	English	2	2021
Kenya	First Updated NDC	English	2	2020
Liberia	First Updated NDC	English	2	2021
Malawi	First Updated NDC	English	2	2021
Mauritius	First Updated NDC	English	2	2021

Mozambique	First Updated NDC	English	2	2021
Namibia	First Updated NDC	English	2	2021
Nigeria	First Updated NDC	English	3	2021
Rwanda	First Updated NDC	English	2	2020
Sao Tome and Principe	First Updated NDC	English	2	2021
Seychelles	First Updated NDC	English	2	2021
Sierra Leone	First Updated NDC	English	2	2021
Somalia	First Updated NDC	English	2	2021
South Africa	First Updated NDC	English	2	2021
South Sudan	Second Updated NDC	English	2	2021
Sudan	First Updated NDC	English	3	2022
Uganda	First Updated NDC	English	3	2022
United Republic of Tanzania	First Updated NDC	English	2	2021
Zambia	First Updated NDC	English	3	2021
Zimbabwe	First Updated NDC	English	2	2021

After selecting the countries to be assessed as indicated in *Table 1*, the next step was to examine the NDC documents and extract information that possibly answers the research questions listed below:

1. What processes and methods are used to determine financial needs in NDCs?
2. How effective/robust are the processes and methods in determining financial needs?
3. To what extent are the processes and methods described in NDCs?

Most NDCs do not specify which methods or processes have been used to estimate the cost of adaptation; however, some provide information describing the processes used but without clear categorization (Guzmán et al., 2022). Therefore, a range of techniques (Table 2) were considered to help classify the descriptions provided in NDCs into costing methods to simplify the comparative analysis (UNFCCC, 2022a). This approach proved practical due to the complexity involved in costing adaptation measures and the lack of universal methods for assessing adaptation costs.

Table 2: Processes and Methodologies for determining Adaptation Finance Needs

Source: (UNFCCC, 2022a)

Climate Finance Analysis:	Identify available and potential sources of climate finance, including domestic budgets, international climate funds, private sector investments, and grants.
Computable General Equilibrium Modelling (CGE)	Macroeconomic models that allow an analysis of how impacts move across different sectors. These models often make use of sector impact assessments, cost analysis, adaptation cost and benefit as inputs for the model
Decision support tools:	Identifies adaptation priorities to generate cost estimates. These can include standard decision-making tools, cost-benefit analysis, or cost-effectiveness analysis, which are often suitable for no- or low-regret adaptation but do not account for uncertainty.
Econometric modelling:	Statistical analysis of current climate and economic connections. It uses the relationships to look at the future impacts and considers potential adaptation costs.
Integrated assessment models:	Models that combine scientific and economic aspects within one integrated analytical framework. These models quantify the impacts of climate change and the corresponding adaptation costs. These models are normally applied at a global level but can be downscaled to regional and national levels.

Investment and financial flow analysis:	Focuses on the costs of adaptation plans, based on the analysis of current financial flows. It also considers the future financial flows and can apply mark-ups to estimate potential costs.
Scenario Analysis:	Creates different scenarios that outline trajectories for adaptation based on various financial investments. These scenarios can help estimate the financial needs associated with different levels of ambitions.
Sector-integrated assessment (damage costs):	Involves the use of sector models at a global, regional, national, or local level to assess future climate change impacts, technical adaptation solutions, and the costs and benefits. Commonly used for coastal or river protection.
Sector, Programme, Project, and Activity-based costing:	Focuses on costing adaptation actions. Such exercises can be high-level costing and detailed. They can also accommodate a bottom-up approach for activity budgets.
Stakeholder Consultation:	Engagement with relevant stakeholders such as government officials, the private sector, civil society, and local communities to gather insights on financial needs.

Following identifying processes and methods used to establish the adaptation finance needs, a qualitative analytical framework was applied to the information extracted from NDCs to determine their robustness. The framework included four distinct modules to answer questions related to specific indicators. The framework was developed to assess the adaptation ambition in NDCs (Dixit et al., 2022)—it sets out a qualitative criterion with questions that assess whether certain elements are evident in the adaption component of the NDCs. Therefore, NDCs of selected countries were analyzed to generate responses to each of the questions in the framework *(Table A1)*.

The framework starts with the main questions related to the presence of an adaptation component in NDCs and links to adaptation communications. The main questions are unbundled into sub-questions that look into adaptation planning separately from the NDC planning process to ensure a comprehensive analysis. According to Dixit et al. (2022), with no standard guidance on structuring the adaptation component in NDCs, the best alternative is adopting the guidance for developing adaptation communications presented at COP24. This guidance was used as the first step for the analysis of the NDCs, and over the years, other reports have modified and included additional questions.

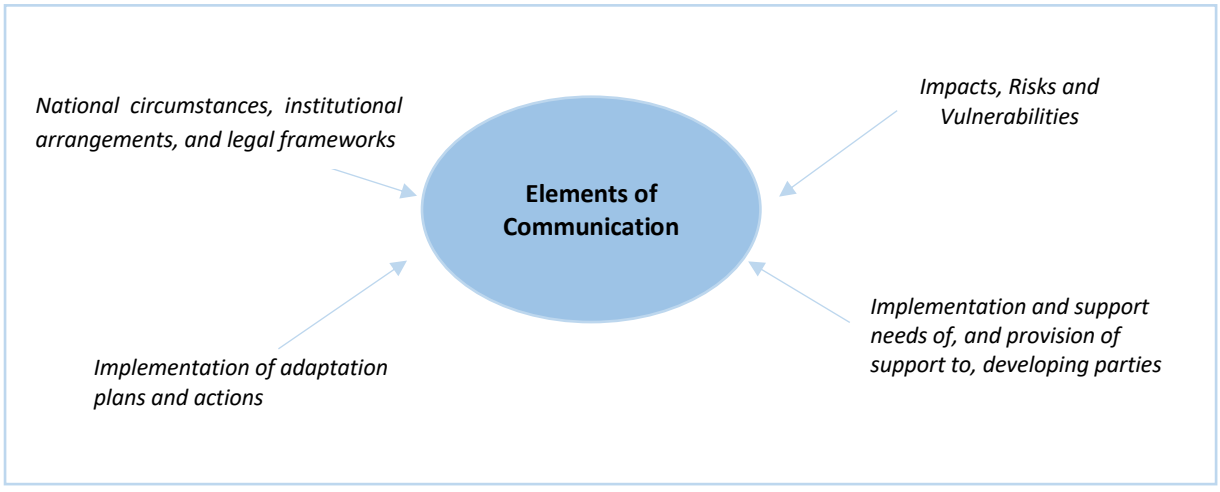


Figure 2: Summary of Elements of Communication

Source: Author; Dixit et al., (2022)

Applying WRI's framework helps determine the robustness of adaptation planning and NDC development processes. WRI's framework is "work that puts forward a bold agenda on adaptation ambition and assessment" (Fransen et al., 2022). The framework aims to extract information from NDCs, which comprises critical '*elements of adaptation communications'*; that is, the information on national circumstances, assessment of expected impacts, risks, vulnerability, and adaptive capacity for all key sectors (Dixit & O'Connor, 2022; Dixit et al., 2022). However, the research underlines the communicated measurement of adaptation finance needs, particularly the implemented processes and methodologies.

WRI provides step-by-step guidance on clearly communicating adaptation priorities, plans and actions, and support needs, which can facilitate effective implementation (Dixit & O'Connor, 2022). This framework builds on the UNFCCC guidance on structuring the adaptation component in NDCs from *Decision 9/CMA.1,* which covers the development of adaptation communications (UNFCCC, 2022b). WRI's report included a table with questions that countries can ask when structuring their adaptation component in NDCs (Dixit et al., 2022). These questions were further modified to develop questions for this assessment. The applicable partial list of the questions and sub-questions derived from the WRI's report is presented in *Table A1*. The table also includes a column explaining how each question addresses the robustness of the processes used in determining adaptation finance needs.

The selected NDCs were also assessed for best practices for developing future adaptation components presented in NDCs (Dixit et al., 2022). The aim is to help strengthen institutional processes that will be helpful to national governments, the UNFCCC, bilateral and multilateral donors, and researchers (Dixit & O'Connor, 2022; Fransen et al., 2022). According to Dixit et al.(2022), when the different elements are presented coherently and logically linked to a country's goals and priorities—communicating that country's contributions and efforts becomes more effective and better understood by third parties, especially potential funders. Furthermore, "by linking the elements with the assessment of related impacts, risks, and vulnerabilities and explaining how strategies, policies, plans, actions, and institutional arrangements are designed to achieve the goals". stated financial support needs are better understood.

Assessing barriers, gaps, and challenges or lessons learned in the process also improves how the communicated adaptation finance needs are received, as this provides the complete picture of the adaptation component in NDCs (UNFCCC, 2020; AfDB, 2021). In addition, providing estimations accompanied by assumptions employed and clear descriptions of the methodological approaches will facilitate understanding the financial support needed to implement the adaptation component in NDCs (Buchner et al., 2021; Guzmán et al., 2022). Alternatively, some countries have included plans to undertake an in-depth analysis and assessment of the estimation of finance needs in a report different from the NDCs (Guzmán et al., 2022).

3.3.1 Presentation of Research Results

Due to the lack of a standardized reporting format for NDCs, this research bundles the research results into four communication elements based on the World Resource Institute's framework on NDC enhancement. WRI's "State of the Nationally Determined Contributions: *Enhancing Adaptation Ambition"* presents the framework in four sections that can be employed to analyze the adaptation

component in NDCs (Dixit et al., 2022:1). According to Dixit et al. (2022) and Fransen et al. (2022), the presence of these elements in the content of NDCs represents the robustness of the adaptation component. As mentioned above, '*elements of adaptation communications'* will be the only part of the framework applied in this research. Therefore, for the purpose of this research, *elements of adaptation communication* provide the assessment indicators that can highlight how robust the NDC processes are in determining adaptation finance needs.

3.4 Limitations

Every research is faced with limitations arising from restrictions in the research methodology or design (Ochieng, 2009). It is essential to acknowledge the possible limitations out of the author's control that might have influenced the study results. Firstly, case studies involve an in-depth examination and analysis of a particular phenomenon; in order to achieve this, there must be rich data *(reliable and verified)* collected from multiple sources (Yin, 2009; Flyvbjerg, 2011; Feagin, Orum & Sjoberg, 2016). To provide a detailed and comprehensive understanding of the case being studied, primary data such as interviews and questionnaires accompany secondary data collected (Rapley, 2017). Due to the scope of the research and limited access to national representatives, only secondary data was collected for this study.

To overcome this limitation, the author adopted an adaptation framework designed by the World Resource Institute (WRI), which is considered to be "work that puts forward a bold agenda on adaptation ambition and assessment" (Fransen et al., 2022). In addition to the limitations mentioned above, the sample size for this study was shrunk due to language barriers and submission dates. Even though 51 African countries submitted new or updated NDCs, only 27 were in English or had a translated version. To avoid the mistranslation of data, 24 NDCs were not selected for this study, potentially influencing the research results.

Furthermore, the cut-off submission date for NDCs selected for the study was 2020 and beyond; any submissions before that deadline were also not selected. The submission date cut-off had limited influence since the research objective is based on the mandate ratified after COP 25 in 2019, aiming for implementation in the new or updated NDCs in 2020. Nevertheless, the data available was sufficient for the study as it covered the entire continent with each region represented. Despite the limitations in the sample selection process, it provided significant relationships from the data and achieved representative population distribution (Yin, 2014; Feagin, Orum & Sjoberg, 2016).

It is undeniable that data analysis would have been more conclusive if coupled with interviews of the experts involved in the adaptation NDC development process. In addition, conducting interviews would capture certain aspects of developing the adaptation NDCs that were not recorded in NDCs. Lastly, time, budget, and resource constraints were also challenging in conducting an in-depth analysis. However, future research could refine what determines the effectiveness of the outcome of adaptation components in NDCs and analyse them based on a robust parallel process analysis (Dixit et al., 2022; Fransen et al., 2022). "Such a process may provide more substantial evidence for the role of causal factors that drive adaptation NDC development" (Dixit & O'Connor, 2022:6).

This chapter summarises the research design, including the main design decisions and limitations, and discusses the study's implications for future research. It outlined how and why subjects were chosen for this study. Data collection methods and steps taken to ensure validity and reliance of the data studies in order to demonstrate that the exploration conducted for this paper followed conventional procedures for a qualitative research methodology. The following chapter will present the above research results and discuss the selected countries' findings for the case study.

Chapter 4: Research Results

4.1 Overview of Research Results

The assessment of adaptation finance needs determination processes in Nationally Determined Contributions (NDCs) reveals significant variations among the research subjects. As shown in Table 3, different countries adopted diverse approaches. A top-down method was prevalent in Egypt, Rwanda, and Seychelles, emphasizing centralized planning. In contrast, a bottom-up approach, focusing on localized or sector-specific plans, was adopted by Ethiopia, Mauritius, and Uganda. Countries like South Africa and Namibia employed a mixed/participatory approach, integrating stakeholder input into their strategies.

The research also examined critical elements, including personnel involvement, process descriptions, and the robustness of methodologies. As outlined in earlier chapters, government-led efforts typically facilitated stakeholder consultations to align with national priorities. These stakeholders included civil society organizations, marginalized groups, technical experts, and international partners. However, some countries lacked detailed documentation of stakeholder engagement and the extent of their involvement.

Each approach had implications for the inclusivity, accuracy, and effectiveness of adaptation strategies. Countries offering detailed process descriptions—such as reviewed documents and working papers—showed stronger frameworks. However, financial estimation methods were less comprehensive, primarily due to insufficient data and expertise. For instance, Guinea-Bissau relied on outdated data, while Angola faced technical capacity limitations, affecting the accuracy of their financial projections.

Key financial insights are summarized in Table 3, highlighting countries with the largest budgets, highest GDP allocations, and significant per capita spending. Egypt ($50B) and Ethiopia ($40B) lead in total budget allocation, emphasizing investments in agriculture, water, and development sectors. Somalia also commits substantial funds ($48.5B) relative to its GDP. Notably, Rwanda (5.7%), Ethiopia (5.4%), and The Gambia (5%) allocate the highest shares of their GDP to adaptation efforts.

In terms of process robustness, reliance on external data sources introduced challenges in ensuring contextual relevance. The top-down approach, while efficient for centralized planning, limited local input, reducing the adaptability and effectiveness of measures. Moreover, many processes lacked clear differentiation between conditional and unconditional financing. Although Ethiopia demonstrated a rigorous, sector-specific, data-driven approach, limited stakeholder transparency diminished its robustness. The depth and clarity of financial analysis methods significantly influenced the overall strength of processes, with less detailed explanations resulting in reduced analytical rigor.

Overall, the research highlights the complexity and variability in determining adaptation finance needs within NDCs. It underscores the need for improved capacity-building, enhanced data quality, and more inclusive stakeholder engagement to strengthen the robustness and relevance of adaptation finance processes.

Table 3: Overview of Research Results.

Source: Author

Country	Budget Total (USD)	Approach	Sectors Covered	Time Frame	% of GDP	Population Size (millions)	$ per capita/year
Angola	144 million	Mixed (Top-Down with benchmarking)	Agriculture, Water, Energy	2020-2035	~1.2%	36.7	~$3,306
Egypt	50 billion	Top-Down	Agriculture, Water Resources, Coastal Zones, Urban Development	Up to 2030	~4%	112.7	~$4,100
Ethiopia	40 billion	Bottom-Up	AFOLU, Water, Disaster Risk Reduction, land restoration and drought resilience.	2018-2030	~ 5.4%	126.5	~$1,033
The Gambia	300 million	Integrated (Strategic Programme)	Various Sectors	Up to 2045	~5%	2.8	~$906
Ghana	2,934.2 billion	Top-Down	Various Sectors	Up to 2030	~3.5%	34.4	~$2,277
Guinea-Bissau	68 million	Portfolio-based	Agriculture, Coastal Management	N/A	~4.6%	2.1	~$875
Liberia	90 million	Mixed (Participatory)	Coastal Zones, Agriculture, Health	Up to 2025	~3.8%	5.6	~$676
Malawi	4.5 billion	Top-Down	Various Sectors	2020 - 2040	~2.5%	21.6	~$625
Mauritius	2.9 billion	Bottom-Up	Various Sectors	2021 - 2030	~4.7%	1.27	~$9,926
Namibia	1.7 billion	Mixed (Participatory)	Agriculture and Fisheries, Forestry and Coastal zones	upto 2030	~3%	3.03	~$5,388
Rwanda	5.3 billion	Top-Down	Various Sectors	upto 2030	~5.7%	14.26	~$968
Seychelles	339 million	Top-Down	Agriculture, Water Resources, Coastal Zones, Urban Development	upto 2030	~5%	0.233	~$18,623
Sierra Leone	1 billion	Mixed (Participatory)	Water, Agriculture, Forestry, Settlements, Biodiversity, and Disaster Risk Reduction	upto 2030	~3.9%	8.64	~$524
Somalia	48.5 billion	Top-Down	Agriculture, Livestock, and Fisheries; Forests; Biodiversity, Ecosystem, and Sustainable wetland management	upto 2030	~2.8%	19.01	~$544
South Africa	16 to 267 billion	Mixed (Participatory)	Agriculture, Livestock, and Fisheries; Forests; Biodiversity	2021 - 2030	~1.4%	64.01	~$6,758
South Sudan	376.3 million	Mixed (Participatory)	Agriculture, Water Resources, Coastal Zones, Urban Development	over a period of 10 years	~4%	11.94	~$438
Sudan	4 billion	Top-Down	Water, Food security, and Health sectors and National development	upto 2030	~2.6%	50.45	~$740
Uganda	17.7 billion	Bottom-Up	Various Sectors	2021 - 2030	~5%	50.02	~$951
United Republic of Tanzania	19 billion (combined with mitigation)	Mixed (Participatory)	Various Sectors	2021 - 2030	~5.4%	68.56	~$1,186

4.2 Country Analysis

This Chapter focuses on assessing the processes and methods used to determine financial needs in NDCs. The Chapter consists of an analysis of each selected country per the criteria described in Chapter 3. Based on the information available in the submitted NDCs, each country will be assessed for the time-period adaptation finance is calculated for, the key personnel involved in the process, the extent to which the processes and methods are described in NDCs and finally, the robustness of the processes and methods.

Angola

Based on the content analysis of Angola's updated NDC, stakeholder consultations were used to determine the financial needs for climate change adaptation. The period for which adaptation finance is calculated is implicitly mentioned; however, one can assume the figures presented are for the period between 2020 and 2035 because of the National Strategy for Climate Change that guided the preparation of the NDC. Angola described the process by including the list of all the relevant documents and working papers reviewed to inform their decision. However, the stakeholders involved in this process are not mentioned.

The government led this process as they organized and facilitated the bilateral consultations to discuss and establish relevant measures to respond to the main priorities of the country (Republic of Angola, 2021). The main objective was to ensure that their NDC was fully aligned with the country's development vision and reflected the feedback from key stakeholders. Budget figures were presented based on the estimates from a benchmarking exercise with similar adaptation measures developed in comparable countries to establish the funding requirements for the identified adaptation measures (Republic of Angola, 2021).

Budgets are a crucial process as they help to plan, allocate, and monitor the use of financial resources (Guzmán et al., 2022; UNFCCC, 2022a). Using benchmarks to estimate financial needs helps establish reference points that improve decision-making and identify gaps within a budget (Buchner et al., 2021). However, using benchmarks in a budgeting analysis can also pose challenges and limitations, such as finding reliable and comparable benchmark data, particularly for context-based adaptation measures. Additionally, benchmark data may not reflect the country's latest or most relevant changes or conditions that need prioritization.

From this process, Angola provided an estimated cost for adaptation of about 144 million USD across all sectors – with an almost equal split between conditional and unconditional measures (Republic of Angola, 2021). The country points out that procedural delays and high costs associated with updating and reviewing processes led to the choice of method and, subsequently, the figure reported (Republic of Angola, 2021). They acknowledged the gaps in technical knowledge for preparing and approving projects, plans, and programs as the main challenge in determining their financial needs (Republic of Angola, 2021).

Overall, using engagement with stakeholders guided by the benchmarked budgets to establish financial needs is considerably efficient. However, to implement adaptation measures, the actual budget is still required to determine the financial need.

Egypt

Egypt followed a top-down approach to determine its adaptation financial needs through its National Climate Change Council (NCCC) (the Arab Republic of Egypt, 2022). The council formulated adaptation policies, namely the National Strategy for Adaptation to Climate Change and the National Strategy for Disaster Risk Reduction 2030, which addressed the country's climate change risks and vulnerabilities (the Arab Republic of Egypt, 2022). According to UNFCCC (2022), policy-based approaches often limit climate activities to those referenced in national policy documents. The approach can sideline marginalized and excluded groups, leading to less effective adaptation measures.

Egypt's adaptation interventions were presented as projects across sectors, including agriculture, water resources, coastal zones, and urban development (the Arab Republic of Egypt, 2022). Project-based costing has been popular among many African NDCs (Guzmán et al., 2022). However, it requires high-level costing exercises and a bottom-up approach to identify activity budgets for implementation. Since Egypt followed a top-down approach for this costing method, the process can be viewed as less efficient, considering the nature of adaptation that often requires input from the directly impacted communities (Guzmán et al., 2022; UNFCCC, 2022a).

Egypt derived its financial estimates from the required capital expenditure to implement adaptation programs up to 2030 (the Arab Republic of Egypt, 2022). The estimates also included the financial needs for capacity building, technology transfer, and the human resources needed for implementation (the Arab Republic of Egypt, 2022). The total cost required amounted to 50 billion USD – which is conditional. Egypt's adaptation targets depend primarily on international finance (the Arab Republic of Egypt, 2022). The country does not explicitly specify the amount required from external parties. However, they mention that several sectoral projects have been implemented through pilot projects financed by national and international funders, making it challenging to separate conditional from unconditional interventions (the Arab Republic of Egypt, 2022).

Ethiopia

Ethiopia's NDC updating process carried out a series of steps, including extensive document review, model development, validation, and stakeholder consultation (Federal Democratic Republic of Ethiopia, 2021). The National Adaptation Plan (NAP) mainly guided reporting cost estimates of adaptation interventions in their NDC. The calculations were established through a sector-based vulnerability assessment and cross-references from the country's 10-year development plan and the Sendai Framework for Disaster Risk Reduction (Federal Democratic Republic of Ethiopia, 2021).

A sector-based assessment involves using sector models to assess future climatic changes, technical adaptation responses, and associated costs and benefits (UNFCCC, 2022a). This method provides a structured approach to understanding, prioritizing, and implementing adaptation strategies tailored to the specific challenges faced by different sectors in the face of climate change (UNFCCC, 2022a).

Furthermore, it evaluates the financial needs based on adaptation. This type of assessment is essential for guiding the allocation of financial resources to climate actions in a targeted and effective manner (UNFCCC, 2022a).

Ethiopia established about 52 relevant sectoral climate resilience and adaptation strategies, later prioritized to ensure effective and efficient utilization of scarce resources for up to 2030 (Federal Democratic Republic of Ethiopia, 2021). The prioritization approach followed an internationally recognized and widely used analytical *PESTLE framework (Political, Economic, Social, Technological, Legal, and Environmental)* for multi-criteria decision-making; each category was applied to evaluate each adaptation option. The exercise found that AFOLU *(Agriculture, Forestry, and Other Land Use)* actions represented the bulk of the adaptation interventions and also required substantial financial aid to be implemented.

Furthermore, Ethiopia applied detailed and quantified adaptation baselines (2018) against 2030 targets for each adaptation intervention to help with the cost estimates (Federal Democratic Republic of Ethiopia, 2021). Ethiopia's NDC described this process as lengthy, rigorous, and informed by a broad range of national, sectoral, and technical studies. However, stakeholders or experts involved in the process are not mentioned. Nevertheless, the country presented a clear demarcation between conditional and unconditional adaptation inventions, with 80 percent of the 40 billion USD constituting their adaptation finance needs that require international and donor financing (Federal Democratic Republic of Ethiopia, 2021).

The Gambia

The Gambia considers its National Adaptation Plan (NAP) one of the most suitable vehicles for addressing its adaptation needs. The NAP was developed based on national-level inputs from consultations with key stakeholders, who discussed the country's climate vulnerability, anticipated adaptation action, and financial needs (The Gambia, 2021). However, The Gambia does not mention the key stakeholders or the experts involved in this process. For the NDC process, The Gambia took an integrated approach to its adaptation planning and implementation after transitioning from a project-based approach.

Under an integrated approach, the country implemented the Strategic Programme for Climate Resilience (SPCR), which provided a comprehensive integrated adaptation framework tailored to the country's needs (The Gambia, 2021). This approach combines scientific and economic aspects of climate change into an integrated analytical framework. It then quantifies the economic impacts of climate change, including the costs and benefits of adaptation.

The NDC report indicates that the cost estimates for adaptation are a direct reference to the estimates in the NAP and the outlines of the SPCR. The Gambia states that using the NAP as a guide enabled the country to take on climate change adaptation more coherently and efficiently (The Gambia, 2021). In addition, the NAP process provided the tools, systems, and information replicated to mainstream adaptation into existing and future policies, programs, and activities across levels and sectors (The Gambia, 2021).

On the other hand, the Strategic Programme for Climate Resilience covered a provisional financing plan with short-, medium-, and long-term implementation costs (The Gambia, 2021). The programme components covered a period of 25 years. The breakdown of amounts is also subject to detailed programming and sequencing of investments. The cost estimates represent working budgets, not the final investment amounts – these figures were generated provisionally to update the NDC. Furthermore, the elements of the SPCR can be revised during the actual programming of activities; this means that the cost estimates can also be offset, increased, or reduced depending on changes made to a program (The Gambia, 2021).

The Gambia indicates that the implementation of the SPCR will be wholly conditional on receiving international support in the form of finance, technology transfer, and capacity building (The Gambia, 2021). Even though a cost breakdown based on the components of each pillar, with a total of over 300 million USD, is reported, The Gambia does not demarcate the conditional from unconditional adaptation actions (The Gambia, 2021).

Guinea-Bissau

According to Guinea-Bissau's NDC, there has been little to no progress in national policies related to adaptation in recent years (Republic of Guinea-Bissau, 2021). With no specific national adaptation policy, the country relies on various sectoral policies incorporating adaptation measures (Republic of Guinea-Bissau, 2021). The adaptation measures reported in their latest NDC were provisional and are currently under review and prioritisation at the national level. The main challenge is the lack of in-depth analyses of climate risk and vulnerability, whether in the sectors or different geographic regions (Republic of Guinea-Bissau, 2021).

Guinea-Bissau acknowledges its shortcomings and inability to articulate its adaptation needs within a framework of what is feasible. However, the government and its cooperating partners decided to refer to the National Adaptation Programme Action (NAPA) to support the measures and costs proposed in the NDC (Republic of Guinea-Bissau, 2021). The national government alludes that even though the NAPA was produced in 2006, some of the priorities listed there remain valid. It is worth noting that most of the aspects of the NAPA are either generic or outdated to address the multifaceted climate change challenges currently faced by Guinea-Bissau (Republic of Guinea-Bissau, 2021).

In terms of adaptation finance needs, Guinea-Bissau provided pipeline estimates from its portfolio of adaptation projects (Republic of Guinea-Bissau, 2021). The portfolio carries out a historical, current, and forward-looking analysis of the adaptation projects. However, the projects are reported based on donors and the status of the projects. According to UNFCCC (2022b), "Portfolios help identify a set of options that are effective over a range of plausible future conditions, as opposed to one option that is optimal for one future." Therefore, it is useful when many adaptation options are available to achieve a goal. However, the lack of good data makes it challenging to achieve the desired outcome.

Guinea-Bissau's cumulative portfolio sum is 68 million USD, of which 30.6 million USD is invested in ongoing projects (Republic of Guinea-Bissau, 2021). It is also unclear how much the financial need is, as the estimates are aggregated (Republic of Guinea-Bissau, 2021).

Liberia

Liberia updated its NDC through a stakeholder engagement process. The process employed a "whole-of-government-whole-of-society participatory approach" (Republic of Liberia, 2021:4). "Stakeholders were placed into two broad categories: the widely recognized stakeholders, who are frequently consulted, and the vulnerable groups who are not regularly recognized" (Republic of Liberia, 2021:5-6). Key stakeholders included technical experts, national and sub-national government officials, women, youth, the private sector, non-governmental organizations, and civil society(Republic of Liberia, 2021). Liberia took a step further in its process by engaging in regional and city segments to ensure the full participation of a cross-section of the citizenry.

The well-thought strategy listed key stakeholders and rolled out consultation plans to ensure meaningful engagement and participation of all stakeholders in the NDC revision process (Republic of Liberia, 2021). The preliminary phase of the stakeholder consultation involved a detailed assessment of adaptation measures and opportunities in existing and proposed critical sectors (Republic of Liberia, 2021). The process relied on the technical analysis of all the sectors and workshop reports to determine the NDC costing and cost-benefit analysis of adaptation measures (Republic of Liberia, 2021).

Liberia also points out critical national planning documents used in this process, such as its "intended NDC, the National Climate Change and Response Strategy (2018), Liberia's Second National Communication, State of the Environment Reports, and Liberia's first Biennial Update Report (BUR)" (Republic of Liberia, 2021:9). These documents helped align their adaptation goals with the national government's Pro-poor Agenda for Prosperity and Development (PAPD) and its long-term sustainable development vision for 2030 (Republic of Liberia, 2021).

The NDC costing and Cost-Benefit Analysis (CBA) estimated a total investment of almost 90 million USD for adaptation targets up to 2025 (Republic of Liberia, 2021). "Cost-benefit analysis appraises options in terms of their monetary value, weighing the life-cycle costs of options against projected benefits, with the option with the highest net present value or benefit–cos ratio selected" (UNFCCC, 2022b). Such an analysis requires establishing a baseline against which costs and future expected benefits are measured, which is challenging. The method does not explicitly deal with uncertainty.

While Liberia manages to provide its adaptation costs, it does not explicitly state its conditional and unconditional adaptation targets. The country acknowledges the need for external parties and sources, mechanisms, and instruments (Republic of Liberia, 2021). The NDC reports on the revision process in detail, with little information on the Cost-Benefit Analysis on which the estimates are based (Republic of Liberia, 2021).

Malawi

According to Malawi's updated NDC, the adaptation component consists of refined adaptation measures based on priority sectors as identified in its INDC and confirmed in national policies, programs, and plans (Republic of Malawi, 2021). Malawi also employed its National Resilience Strategy (2018-2030), which enabled cross-sector collaboration in planning and delivering adaptation efforts.

It is reported that this approach strengthened governance in supporting the coordinated implementation of interventions, which was a prior challenge for the country (Republic of Malawi, 2021).

Malawi engaged an Adaptation Expert Working Group (EWG) to assist with analyzing the proposed adaptation measures (Republic of Malawi, 2021). The EWG helped prioritize adaptation measures and coupled them with indicators to measure and evaluate their progress toward targeted outcomes, along with cost estimates (Republic of Malawi, 2021). Malawi also involved other stakeholders in this process, requesting their inputs from reviewing and validating the set of measures, its proposed Monitoring and Evaluation framework, and the cost estimates (Republic of Malawi, 2021).

As mentioned, adaptation measures, performance indicators, and targets were developed sectorally. Furthermore, adaptation options were identified relating to three pillars: "institutional framework; knowledge, technology, and financing; and resilience of the most vulnerable" (Republic of Malawi, 2021). These pillars would support the following objectives.

(i) Promotion of an environment that enables the mainstreaming of climate change adaptation.
(ii) Enhancement of data capacity, and information management and sharing.
(iii) Improve access to technology and finance for adaptation measures.
(iv) Better planning and implementation of adaptation measures that increase the resilience of the most vulnerable communities in Malawi.

Malawi established estimates for adaptation measures for different periods through 2040. These cost estimates were calculated using different planning documents, experts' feedback, and scaling based on the costs of similar projects (Republic of Malawi, 2021). The total estimated cost for adaptation measures is around 4.5 billion USD. The total is split between two decades, with the first decade requiring about one-third and the remaining in the subsequent decade (Republic of Malawi, 2021).

The unconditional measures account for around 47 percent of the estimated funding requirements, and conditional actions account for around 53 percent. "The estimates also show how the bulk of the support is required over the coming decade, reflecting the need to mobilize adaptation funding to prepare and manage climate impacts and risks expected to increase in Malawi over the near term" (Republic of Malawi, 2021).

Mauritius

Mauritius centers its NDC adaptation actions around its 2021 National Climate Change Adaptation Policy Framework. The framework provides nature-based solutions for adaptation in key sectors (Louis & Republic of Mauritius, 2021). Mauritius aims to enhance its knowledge base regarding climate change risks and impacts on communities. The country takes an integrated approach, combining sectors in developing and implementing adaptation measures (Louis & Republic of Mauritius, 2021). The Department of Climate Change (DCC) in the Ministry of Environment, Solid Waste Management and Climate Change led the coordination with other stakeholders. The stakeholder engagements addressed the national circumstances for adaptation.

Based on the NDC report, Mauritius relied on collaborations and consultations with various stakeholders, including academics, the general public, and technical experts, to build on existing adaptation options and cost estimates (Louis & Republic of Mauritius, 2021). Mauritius also included representatives of vulnerable groups, such as the youth, women, elderly, and marginalized communities – particularly in the Outer Islands. Specific adaptation actions were dedicated to Rodrigues to adopt coherent and locally adapted actions (Louis & Republic of Mauritius, 2021).

To identify the adaptation actions that are either unconditional or conditional on external financial support received, the Department of Climate Change executed a comprehensive participatory process. The process took a holistic approach and facilitated opportunities for optimizing climate efforts, including possible trade-offs or synergies across the various climate-sensitive sectors (Louis & Republic of Mauritius, 2021). The total financial needs for adaptation were estimated at 4.5 billion USD between 2021 and 2030, with 65 percent representing conditional finance from international sources and donor agencies.

Namibia

Namibia is considered one of the most vulnerable countries to climate change impacts, hence the relevance of adaptation, especially for floods and droughts (Namibia, 2021). As a result, ministries such as Agriculture and Fisheries with adaptation relevance proposed priority actions for the county (Namibia, 2021). On the other hand, extensive research and consultation with sectoral leads were conducted to revise the NDC. These also worked on separating conditional and unconditional cost forecasts for adaptation measures up to 2030 (Namibia, 2021). Namibia also took a stance on inclusivity of the marginalized and excluded by inviting the youth and women to participate and contribute towards the adaptation actions (Namibia, 2021).

In terms of the costs to adapt, “estimates for each action involved identifying the cost for sub-actions including the upfront capital costs, ongoing maintenance costs, capacity-building or training and human resources needed to implement the action” (Namibia, 2021:39). These estimates were further reviewed against similar actions previously complemented within Namibia at any level (Namibia, 2021). Assumptions on forecasted changes in costs over time were also included in the footnotes of the NDC report; for example, a decrease in costs over time due to lowering technology costs or removing barriers by relevant policies” (Namibia, 2021).

The total finance needs for adaptation actions exceeded 1.7 billion USD, which governmental ministries summarised by the sector (Namibia, 2021). The most significant funding was allocated to agriculture, followed by forestry and coastal zones. About 90 percent of the requested funds depend on international partners’ and donors’ external financial support (Namibia, 2021). The Namibian government joined forces with development stakeholders through the Partnership Plan that seeks to connect international resources for climate action to priority areas set by the government (Namibia, 2021).

Rwanda

Rwanda's updated NDC builds on its existing policies, national plans, and targets for adaptation. A detailed and robust assessment established baselines and sector-level targets for adaptation measures (Republic of Rwanda, 2020). This process involved in-depth analysis of advanced information and data available on sectors by stakeholders (Republic of Rwanda, 2020). Sector working papers, Climate Change Vulnerability Assessment reports, and Strategic Programs for Climate Resilience (SPCRs) were some resources used to assess adaptation options (Republic of Rwanda, 2020).

The extensive stakeholder consultation process also prioritised the adaptation inventions and the likely costs of implementing each action. A total of 24 adaptation interventions were proposed across eight key sectors, with corresponding performance indicators aligned with baselines and targets (Republic of Rwanda, 2020). Rwanda chose this reporting style to meet expected global and national standards from potential investors. This would signal a robust process and show their efforts at addressing the challenges of measuring climate change adaptation (Republic of Rwanda, 2020).

Rwanda's total estimated cost for identified adaptation priorities up to 2030 is over 5.3 billion USD, where unconditional measures take 40 per cent of the total estimated funds and conditional measures around 60 per cent (Republic of Rwanda, 2020). The adaptation measures in this updated NDC were based on quantified targets for resilience and evaluated priority interventions (Republic of Rwanda, 2020).

The following outline steps in the process of identifying and assessing adaptation measures:

- Extensive adaptation document review and sector working papers.
- Analysis of INDC and other recent studies on adaptation to find gaps and establish the vulnerability index for the country.
- Identifying priority sectors based on the NDC Partnership Plan supported by the World Bank.
- Selection of adaptation measures and metrics through a multi-criteria analysis methodology with the help of sector experts and relevant stakeholders.
- Finally, adaptation indicators are set to guide baselines and metrics at different levels.

Lastly, regarding the stakeholder consultation, experts from different sectors followed an analytical framework that guided the collaborative efforts. The representatives from each sector were to do the following.

- Verify the information included in the analytical framework.
- Provide relevant internal reports for MRV of the sector.
- Clarify target projections for 2025 and 2030.
- Agree on the costs of sector-specific adaptation actions, including categorisation of conditional and unconditional.

Seychelles

Seychelles is naturally vulnerable to climate change impacts and risks. As a Small Island Developing State (SIDS), it has to prioritise adaptation actions (Republic of Seychelles, 2021). Seychelles' primary objective is safeguarding its Blue Economy and Blue Carbon ecosystems (Republic of Seychelles, 2021). The adaptation interventions were regulated nationally and locally, prioritising Nature-based Solutions for climate resilience. Seychelles also integrated its climate change adaptation plans and strategies across all key sectors (Republic of Seychelles, 2021).

The costs of implementing adaptation actions are based on a combination of costs derived from national sectoral strategies, ongoing initiatives, and projects with similar objectives (Republic of Seychelles, 2021). As mentioned earlier, Seychelles presented the cost per sector and national strategies with the aggregated cost amounting to 339 million USD (Republic of Seychelles, 2021). It is important to note that Seychelles relied on the information and data reported by the AfDB and Green Climate Fund to determine the costs of its adaptation measures. Lastly, the NDC does not indicate any other processes for costing the adaptation measures or demarcating their conditional from the unconditional financial needs (Republic of Seychelles, 2021).

Sierra Leone

The NDC development process was guided by the Ministry of Environment with technical support provided by the Meteorological Agency (The Republic of Sierra Leone, 2021). These parties determined the climate change risks and impacts on the country. The process also involved engaging stakeholders outside of the government to assist with the decision-making process. The stakeholder engagement was diverse and inclusive, including national, sub-national, municipal, public, private, civil society, and community groups (The Republic of Sierra Leone, 2021). Each stakeholder was assigned a specialised role in the process to ensure effectiveness in building on existing policies and processes toward climate resilience.

In terms of adaptation, the insights gathered from consultations held with stakeholders and the Sector Working Group (SWG) determined the costs for meeting conditional and unconditional targets until 2025 up to 2030 (The Republic of Sierra Leone, 2021). The consultation process involved reviewing the INDC and other sector working papers. Key priorities were drawn from the National Adaptation Plan, reflecting country-driven goals and strategies for adaptation (The Republic of Sierra Leone, 2021). Sierra Leone presented the costs for each strategy and the intended objectives. It also indicated the sectors the adaptation action covers and the targeted period to implement the strategy (The Republic of Sierra Leone, 2021). The costs amount to over 1 billion USD; however, the conditional and unconditional financial needs are not explicitly indicated – one has to link the *categorisation of proposed adaptation actions into conditional and unconditional target'* tables to the *'action plan for implementing the adaptation actions'* table and disaggregate the data (The Republic of Sierra Leone, 2021).

Somalia

The government of Somalia updated its NDC through consultative multi-stakeholder technical and policy dialogues (The Federal Republic of Somalia, 2021). The consultative workshops and engagements involved government institutions, NGOs, CBOs, private sector, academic, and research

institutions (The Federal Republic of Somalia, 2021). The NDC revision process followed the UNFCCC guidelines and Somalia's national development policies, strategies, and action plans. In terms of adaptation, priority actions were identified based on sectoral reviews of various climate change documents and reports from relevant stakeholders consulted (The Federal Republic of Somalia, 2021).

Somalia's 2020 adaptation baseline assessment also informed the prioritization of adaptation options for up to 2030, covering key vulnerable sectors of the economy (The Federal Republic of Somalia, 2021). In addition, the NAPA provided national and sub-national adaptation plans and policies for its medium-term and long-term adaptation actions in priority sectors (The Federal Republic of Somalia, 2021). Somalia also used information from other neighboring countries within the Eastern region of Africa and other similar countries (in terms of fragility, economic and population sizes, and similar growth trajectories). The total cost estimated for adaptation actions amounted to 48.5 Billion USD, which was presented per sector and proposed action (The Federal Republic of Somalia, 2021). The NDC does not provide further information on the process followed to estimate the costs of adaptation actions.

South Africa

South Africa adopted a national adaptation strategy in 2020 to guide its climate change action and inform its adaptation planning (Republic of South Africa, 2021). The strategy provides the adaptation objectives for relevant sectors. Regarding the adaptation component in its NDC, the domestic legislation and policy, sector strategies, and provincial and municipal adaptation strategies/plans were reviewed for estimations of adaptation costs (Republic of South Africa, 2021).

South Africa also relied on the relevant stakeholders to carry out this process; therefore, the country had to put institutional arrangements in place to guide the consultations(Republic of South Africa, 2021). Overall, the Department of Forestry, Fisheries, and the Environment (DFFE) led the stakeholder engagements following a five-step procedure listed below:

- Conducted an initial technical analysis.
- Consulted with the national government.
- Engaged with relevant stakeholders across the nine provinces.
- Held workshops where each province had a public representative.
- The cabinet finalized the outcome.

In terms of adaptation needs, South Africa employed a costing methodology based on the projection of physical climate hazards, including extreme events (Republic of South Africa, 2021). The cost functions, including direct and downstream costs, were calculated based on the present-day climate and near future under the low mitigation scenarios (Republic of South Africa, 2021). The costs estimated are in terms of percentiles. They also cover the uncertainties within a multi-model ensemble (Republic of South Africa, 2021).

Sectors covered include Water, Agriculture, Forestry, Settlements, Biodiversity, and Disaster Risk Reduction. The cost estimates for the period 2021 to 2030 are between 16 and 267 billion USD (Republic of South Africa, 2021). When calculated based on a minimum of 4 percent GDP impact, the

cost will be about 122 billion USD by 2025 and 375 billion USD by 2030 (Republic of South Africa, 2021). South Africa does not indicate its financial need from external sources.

South Sudan

South Sudan engaged various stakeholders to assist with their NDC update process. The stakeholders were assigned roles and responsibilities for implementing climate action (The Republic of South Sudan, 2021). Research institutions actively working on climate change and other relevant sectors were also consulted for input on climate risks and impacts faced by the country (The Republic of South Sudan, 2021). The country also relied on international organizations actively implementing climate-related projects in South Sudan; these included the AfDB, the World Bank, UNDP, and USAID (The Republic of South Sudan, 2021). According to the NDC, the above international organizations played a significant role in cost estimations for the projects for adaptation.

The NAPA document also guided adaptation needs for the country by prioritizing projects that address the urgent need to adapt to climate change (The Republic of South Sudan, 2021). These projects were categorized under five thematic areas: "environment, water resources, agriculture, disaster risk reduction and policy, and institutional framework" (The Republic of South Sudan, 2021:5)—the thematic areas covered medium and long-term adaptation activities.

South Sudan provided preliminary cost estimates of adaptation finance needs based on global marginal abatement cost curves (The Republic of South Sudan, 2021). The estimates require $376.3 million for implementing adaptation actions. Some of the sectors with high costs include agriculture, livestock, and fisheries; forests; biodiversity, ecosystem, and sustainable wetland management (The Republic of South Sudan, 2021). South Sudan committed about 10 percent of the cost and expected the remaining to be financed by external parties for 10 years.

Sudan

Sudan also relied on stakeholder consultations to estimate adaptation costs and financial needs. The National Adaptation Plan (NAP) identified the adaptation measures; however, Sudan points out the need for further analysis and development into informative, high-quality project concepts to enable fundraising (Republic of Sudan, 2021). Overall, Sudan's approach was different from other African countries; the costs were established first to enable decision-makers to prioritize adaptation interventions. Stakeholders further analyzed the projects and initiatives' financial flows and adaptation costs to establish their financial needs (Republic of Sudan, 2021).

In the NDC, Sudan presented project-based costs derived from associated costs and required investment to implement their adaptation measures. Sudan also relied on technical studies and reports from national plans and strategies to establish its financial needs for adaptation measures. The country also pointed out its technical capacity needs that relate to assessing the future vulnerability in areas such as water, food security, and health sectors and national development (Republic of Sudan, 2021). The total cost amounted to 3,850 million USD for ten years up to 2030. However, Sudan does not establish their conditional or financial needs from external parties.

Uganda

Uganda updated its NDC through a whole-of-government engagement involving a sector-wide approach. The approach required full participation from ministries, departments, agencies, and local governments. These stakeholders identified the various climate actions and discussed and prioritized them to ensure alignment with sectoral priorities. Uganda also adopted a whole-of-society engagement that ensured systematic engagement, public awareness, and effective participation. This embraced an approach where society fully participated in a bottom-up approach. "The collaboration with National Planning Authority and the Ministry of Finance, Planning and Economic Development ensured alignment of the update process with the Vision 2040 and development aspirations highlighted in the third National Development Plan (NDP III) of the country" (Uganda, 2022).

Regarding adaptation, Uganda referred to the IPCC 6th Assessment Report (AR6), particularly the regional climate extremes. Uganda took note of the warming trends and projections for annual temperatures, precipitation, and rainfall intensity. This confirmed the climate change risks and vulnerability Uganda is likely exposed to. The stakeholders worked on climate action planning (NDC update) and long-term development, which promoted efficient strategic planning. According to Uganda, the joint modelling for NDC update and LTS scenarios, systematic data and information sharing, and joint progressive planning and pooling of partners support propelled synergy.

Uganda's estimated cost of adaptation of USD 17.7 Billion across all sectors, of which 14 percent is unconditional, and the remaining 86 percent is conditional on international support. Uganda also points out that these funds would address its cross-cutting issues of technology, gender, and capacity building up to 2030. However, little detail is provided concerning the calculation method used to estimate these costs. Uganda does not mention the use of experts apart from the stakeholders mentioned above in reaching these numbers.

United Republic of Tanzania

Tanzania's Environment Department coordinated an extensive consultation process involving relevant stakeholders who developed the climate action presented in the updated NDC (The United Republic of Tanzania, 2021). Workshops and group discussions provided a platform for these stakeholders to present the needs of their respective sectors and interest groups. Some of the participants included the national government, local government, research and academic institutions, and civil society organizations. The NDC also reveals several technical sessions were held to finalize the NDC before submitting the document for approval (The United Republic of Tanzania, 2021).

In terms of adaptation, targets were informed by emission trends, present and future sectoral vulnerabilities, and impacts. Sector experts set the baselines, capturing national interests in addressing climate change. Tanzania followed an implementation plan that cost-prioritized actions per sector. These costs were guided by stakeholder inputs and sector-integrated assessment (The United Republic of Tanzania, 2021). In collaboration with the local government authority, each sectoral ministry prepared sector-specific initiatives (The United Republic of Tanzania, 2021). Each adaptation initiative indicated the specific actions to be undertaken, including the time frame, means

of tracking, costs for implementation, and the source of funding (The United Republic of Tanzania, 2021).

The NDC estimates a total aggregated budget of over 19 billion USD for adaptation and mitigation (The United Republic of Tanzania, 2021). Tanzania presented aggregated figures that did not separate conditional from unconditional adaptation actions. The country highlights a lack of adequate capacity as a barrier to articulating their needs. However, the government emphasizes that undertaking adaptation actions requires resources beyond domestic resources. Therefore, external financial support will determine the success of NDC implementation (The United Republic of Tanzania, 2021).

4.3 Summary

The country analysis established that only ten processes and methodologies were employed in determining adaptation finance needs among the selected countries under review. The table below lists each country's processes and methods used to calculate adaptation costs and needs. Most countries implemented more than one process for their cost calculations, with the popular processes being project-based costing and stakeholder consultations on costs to implement adaptation measures. Based on the findings, South Africa used more processes and methodologies than its peers to determine its adaptation costs. It is also the only country that applied scenario planning to its cost estimations—a method that considers alternative perspectives under different assumptions.

Table 4: List of Processes used to determine Adaptation finance needs.

Source: Author

Process	Countries
Stakeholder Consultation **(8)**	*Angola, Malawi, Namibia, Rwanda, South Sudan, Sudan, South Africa, Uganda*
Technology needs assessment **(1)**	*Egypt*
Capacity Building Assessment **(1)**	*Egypt*
Baseline Assessment **(2)**	*Ethiopia, Somalia*
Project-based **(8)**	*Guinea-Bissau, Malawi, Rwanda, Seychelles, Sierra Leone, South Sudan, Sudan, South Africa*
Cost-Benefit Analysis **(2)**	*The Gambia, Liberia*
Long-Term Finance Planning **(2)**	*Malawi, The Gambia*
Sector-integrated assessment/damage costs **(3)**	*Seychelles, Uganda, United Republic of Tanzania*
Risk assessment **(3)**	*Mauritius, Sierra Leone, South Africa*
Scenario Planning **(2)**	*Sierra Leone, South Africa*

Reflecting on the above findings, it is evident that each country chose a method based on its set goals and objectives, underlying assumptions, and the different views of participating parties. Information and data availability also played a huge role in these assessments; for instance, if no risk assessment has been done, it is hard to assess adaptation options. In addition, financial needs possibly depend on whether the objective is to reduce risks efficiently while accepting a trade-off with higher residual risk or achieving low levels of residual damage and accepting higher adaptation costs (UNFCCC, 2022a).

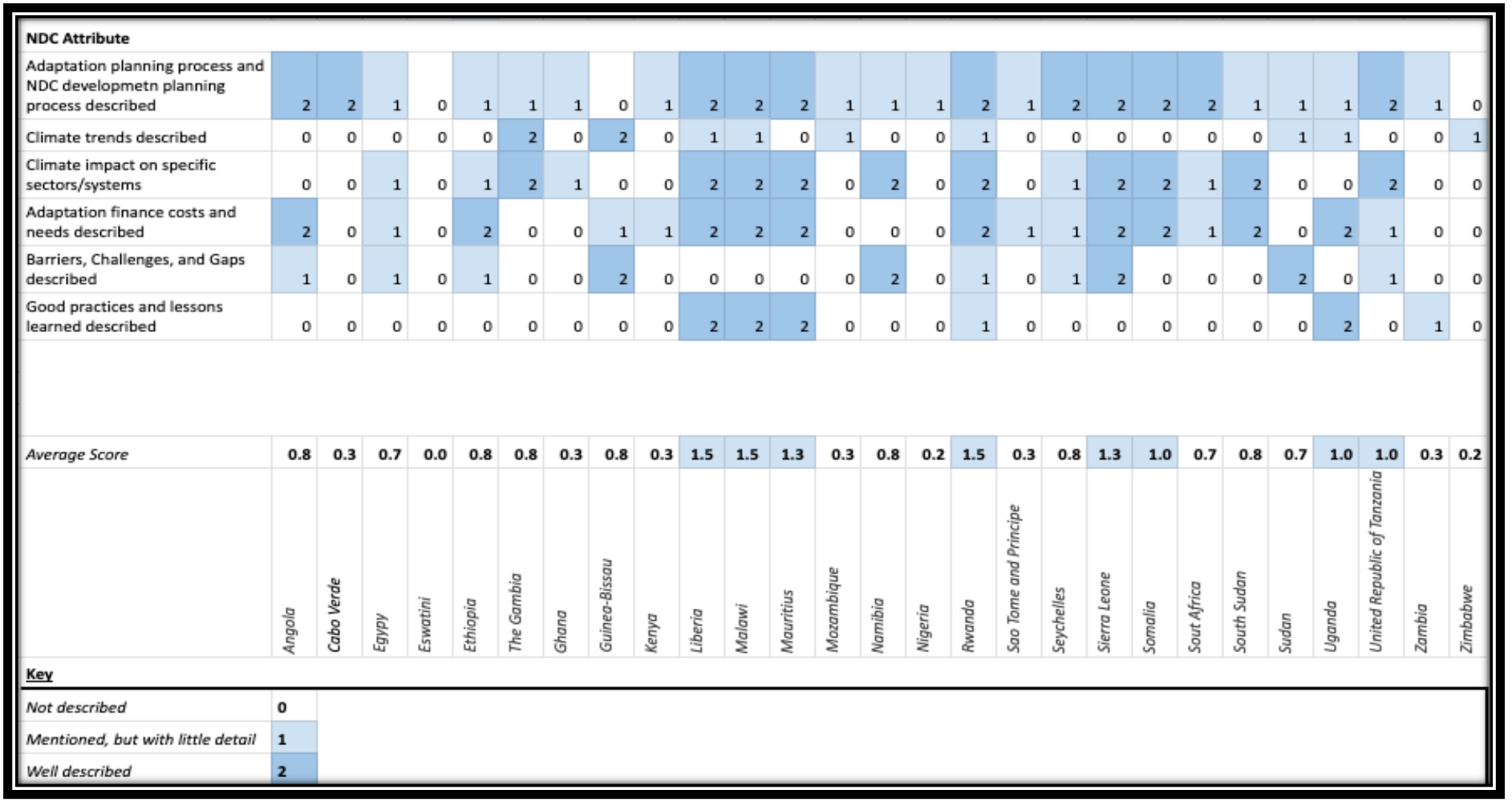
This means that comparisons between methods used by developing countries should be cautiously approached unless coordinated methods and assumptions are employed (UNFCCC, 2022a).

In the context of assessing NDCs for adaptation finance needs reporting, the scoring framework reflects the level of detail in describing adaptation plans, financial needs, and implementation processes. The three main categories—*"well described," "mentioned but in little detail,"* and *"not described"*—represent varying levels of robustness and specificity in reporting adaptation information:

i. **Well Described (Score 2)**: This highest level of detail indicates that the NDCs include both qualitative descriptions and, when relevant, quantitative details. This can mean providing specific examples, clear strategies, or quantitative elements such as estimated costs or financial needs. A well-described adaptation plan may outline expected adaptation outcomes, timelines, and sector-specific goals, providing a comprehensive roadmap that aids both transparency and implementation planning.
ii. **Mentioned but in Little Detail (Score 1)**: NDCs in this category acknowledge certain adaptation processes or needs but lack comprehensive information. Descriptions might be broad or general, such as briefly mentioning the need for sectoral adaptation without explaining sectoral strategies, goals, or estimated costs. This can make it challenging for stakeholders to understand specific needs or priorities and impedes monitoring progress effectively.
iii. **Not Described (Score 0)**: When adaptation processes or information are not described, the NDCs do not address or even minimally mention critical aspects of adaptation planning. This may result from a lack of data, resources, or prioritization, leading to gaps in adaptation reporting. Without any mention, these areas remain unclear, which can hamper the assessment of overall adaptation progress and the ability to attract international support for these needs.

This grading system offers an indicator of NDCs' robustness in adaptation reporting, highlighting areas where more standardized and detailed reporting methods could enhance transparency and support for adaptation actions.

Finally, in the country analysis above, some of the strengths and weaknesses of processes have been discussed. The following Chapter builds on these findings to perform a comparative analysis of the subset of countries that describe the methods used to assess financial need.



NDC Attribute	Angola	Cabo Verde	Egypt	Eswatini	Ethiopia	The Gambia	Ghana	Guinea-Bissau	Kenya	Liberia	Malawi	Mauritius	Mozambique	Namibia	Nigeria	Rwanda	Sao Tome and Principe	Seychelles	Sierra Leone	Somalia	Sout Africa	South Sudan	Sudan	Uganda	United Republic of Tanzania	Zambia	Zimbabwe
Adaptation planning process and NDC developmetn planning process described	2	2	1	0	1	1	1	0	1	2	2	2	1	1	1	2	1	2	2	2	2	1	1	1	2	1	0
Climate trends described	0	0	0	0	0	2	0	2	0	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	1
Climate impact on specific sectors/systems	0	0	1	0	1	2	1	0	0	2	2	2	0	2	0	2	0	1	2	2	1	2	0	0	2	0	0
Adaptation finance costs and needs described	2	0	1	0	2	0	0	1	1	2	2	2	0	0	0	2	1	1	2	2	1	2	0	2	1	0	0
Barriers, Challenges, and Gaps described	1	0	1	0	1	0	0	2	0	0	0	0	0	2	0	1	0	1	2	0	0	0	2	0	1	0	0
Good practices and lessons learned described	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	1	0	0	0	0	0	0	0	2	0	1	0
Average Score	0.8	0.3	0.7	0.0	0.8	0.8	0.3	0.8	0.3	1.5	1.5	1.3	0.3	0.8	0.2	1.5	0.3	0.8	1.3	1.0	0.7	0.8	0.7	1.0	1.0	0.3	0.2

Key	
Not described	0
Mentioned, but with little detail	1
Well described	2

Figure 3: Average Score of Level of Description on Communication elements

Source: Author

Chapter 5: Comparative Analysis

As mentioned in Chapter 4, the comparative analysis focuses on a subset of countries that describe the processes and methods of estimating their cost of adaptation. The comparative analysis seeks to assess the robustness of the different approaches by countries with similar processes and methods. This Chapter builds on the findings from the previous Chapter, such as each country's processes and methods for determining adaptation finance needs. This Chapter further breaks down the elements of communication to provide a better understanding of the WRI's framework in determining adaptation finance needs.

The framework was developed to assess the adaptation ambition in NDCs (Dixit et al., 2022)—it sets out a qualitative criterion with questions that assess whether certain elements are evident in the adaption component of the NDCs. The critical 'elements of adaptation communications' are the information on national circumstances, assessment of expected impacts, risks, vulnerability, and adaptive capacity for all key sectors. For each of the elements, a summary of countries with comprehensive descriptions is also provided for best practices and guidance for countries that seek to improve their NDC reporting.

5.1 National Circumstances, Institutional arrangements, and Legal frameworks

The comparative analysis revealed that all of the selected NDCs included a section of the development process of their NDC and adaptation component. However, only 21 NDCs provided an in-depth planning process for their NDC, while 14 described their adaptation planning process. The information provided included the institutions involved, the level of contributions, the stakeholders consulted, and how the NDC was approved. Liberia, Malawi, Somalia, and Uganda are notable countries with detailed reporting on this element. For instance, Liberia and Uganda provided a descriptive reference of their robust stakeholder engagement process, which promoted a whole-government-whole society participatory approach that ensured a more inclusive adaptation costing process.

Figure 3 also breaks down the number of countries that included or left out details for the coordination process for adaptation planning or with other climate change processes. The analysis established that irrespective of the high levels of stakeholder engagement, there was little evidence of vertical and horizontal coordination during the development process. Only six NDCs mentioned the alignment of adaptation planning with other national or sectoral development plans, policies, or programs. Malawi engaged an Adaptation Expert Working Group as a step further to refine the alignment of adaptation to other national policies, programs, and plans, such as their National Resilience Strategy (2018-2030). The prioritized adaptation measures together with indicators to measure and evaluate their progress toward targeted outcomes and cost estimates.

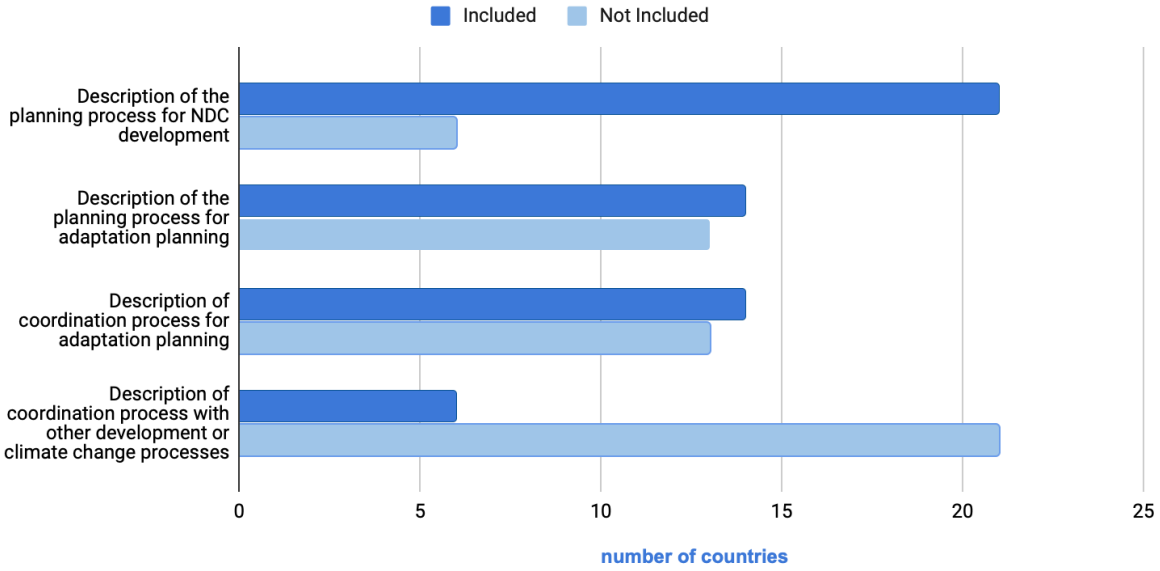


Figure 4: Element of communication on National Circumstances, Institutional arrangements, and Legal frameworks

Source: Author

On the other hand, Somalia describes its collaborative efforts with NGOs, CBOs, the private sector, and academic and research institutions throughout the process. Somalia used various channels to coordinate through policy dialogues, engagements, workshops, and expert consultations. In Eswatini, the coordination involved sessions with marginalized groups' representatives, and their findings were validated by a Technical Advisory Group and other relevant stakeholders. Overall, this element was included in depth by most NDCs as compared to the other elements of the WRI framework. This could result from countries using information and data from other national documents covering adaptation.

5.2 Impacts, Risks and Vulnerability

In terms of the short and medium-term trends in climate change, ranging between 2030 and 2050, only ten NDCs provide details of the adaptation measures for the anticipated climatic changes. Long-term trends up to the year 2100 were briefly described in 6 NDCs. The Gambia's Third National Communication (TNC) presented projections of annual mean temperatures and rainfall patterns for periods between 2000 and 2050 up to 2100. The Gambia further illustrates the expected pressure on the country's natural and societal systems, such as the decrease in rainfall and projected increased salinization and acidification of lowland soils (The Gambia, 2021).

The Gambia lays out specific measures it intends to adopt in the short and medium term towards a climate-resilient pathway that aligns with the above-mentioned climate change trends. These measures included regulations, policies, subsidies, incentives, international markets, and legal infrastructure (The Gambia, 2021). The Gambia aims to achieve these adaptation measures through education, development, and implementation of socioeconomic climate change research.

Figure 4 shows the high physical climate change impact on sectors or systems reported in NDCs. This is attributable to the relevant stakeholders' excellent

coordination during adaptation planning, especially sectoral experts. For instance, Rwanda relied on sector working papers during the planning process and consulted sectoral experts before finalizing the revised NDC. South Sudan, Seychelles, and Mauritius held assessments with sectoral experts to ensure the accuracy and completeness of climate change impacts and vulnerability of sectors. Overall, most of the NDCs scoped and designed their adaptation projects based on the climate change impacts faced by a sector or system. Malawi describes a sectoral framework that helps develop measures to enhance their adaptation and resilience; this framework builds the adaptation actions, prioritizes them, and estimates the funding requirements. However, a small number of NDCs describe the vulnerabilities and climate risks faced by specific groups such as indigenous people, women, children, the elderly, and the youth.

Figure 5: Element of communication on Impacts, Risks and Vulnerabilities.
Source: Author

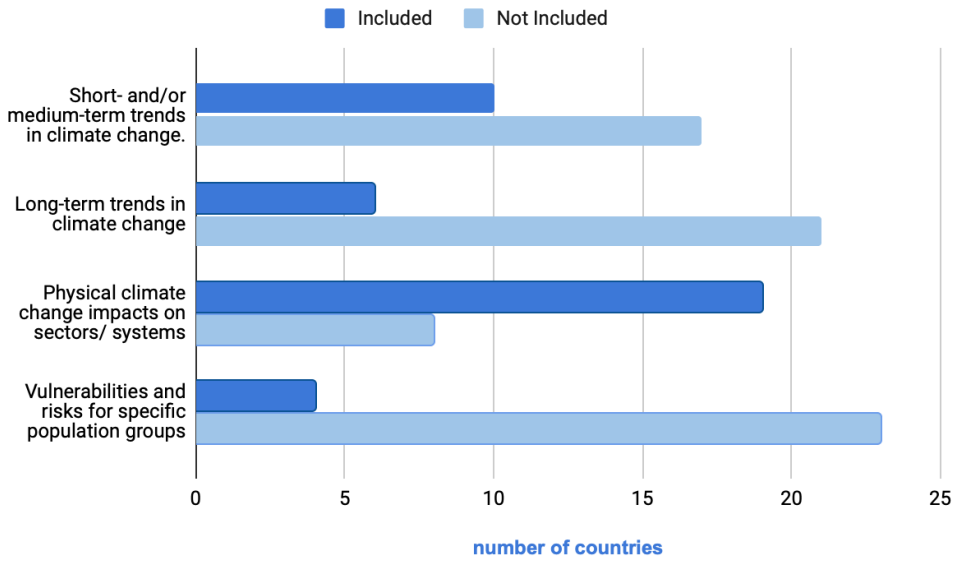


Figure 5: Element of communication on Impacts, Risks, and Vulnerabilities.

Source: Author

Meanwhile, Mozambique projected its short-medium-long term climate change trends based on climatological modelling from 32 synoptic weather stations. Mozambique employed seven general circulation models to project future climate scenarios for the country, focusing on the mid-century (2046-2065) and late-century (2080-2100) periods (REPUBLIC OF MOZAMBIQUE, n.d.). The projected trends were linked to strategic adaptation actions and resilience measures in response to climate change.

Guinea-Bissau provides climate scenarios based on the representative concentration pathway (RCP). In the short-term climate scenario between 2016 and 2045, predictions were made for RCP4.5 and RCP8.5, citing changes in temperature and rainfall patterns in different country zones, such as the countryside and coastal regions. For the medium-long term (2046 to 2100), the same RCPs were employed to predict the climatic changes the country would likely experience. These projections were

also aligned with adaptation measures included in their NDC. The rest of the NDCs assessed based their short-term trends on the IPCC 6th assessment report (AR6) that indicated warming trends observed and projected to continue over the 21st century. These countries also relied on the generalized annual temperature and rainfall intensity scenarios for the continent (Africa) shown in this assessment report for their adaptation efforts.

Vulnerable groups include individuals exposed to poverty or individuals with low income. Climate-vulnerable groups are communities negatively impacted by climate change and have limited ability and income to recover. Mozambique provides a detailed summary of the impacts of extreme weather events at the human level, indicating the loss and damage experienced by vulnerable communities. Mozambique uses these past events to establish adaptation areas to be prioritized. South Sudan and Carbo Verde take a similar approach by linking their adaptation strategies to target groups vulnerable to climatic changes and promoting job creation in those adaptation processes.

5.3 Identifying Financial needs for implementing Adaptation priorities

The research found that 21 NDCs identified their financial needs for tackling climate change. These countries provided their adaptation costs disaggregated from those of mitigation measures—a strategic approach that facilitates robust climate action (Guzmán et al., 2022). The disaggregation of costs also allows better resource management and prioritization of policies (AFDB, 2013; UNFCCC, 2020). Countries such as Carbo Verde, Mozambique, Nigeria, Sao Tome, Zambia, and Zimbabwe failed to present their adaptation costs and needs in their Nationally Determined Contributions. Still, they indicated that adaptation measures will be costed in their National Adaptation Plans instead. This information could not be verified as the study solely focused on NDCs.

As indicated in *Figure 5*, the research also looked at countries that separated their conditional from unconditional adaptation costs. Providing the separated costs helps determine the financial needs for existing levels of expenditures on adaptation as well as any incremental financing requirements (UNFCCC, 2020; Halimanjaya et al., 2021a). In such an instance, conditional adaptation costs require external financing and are typically considered the financial need that national governments cannot self-fund.

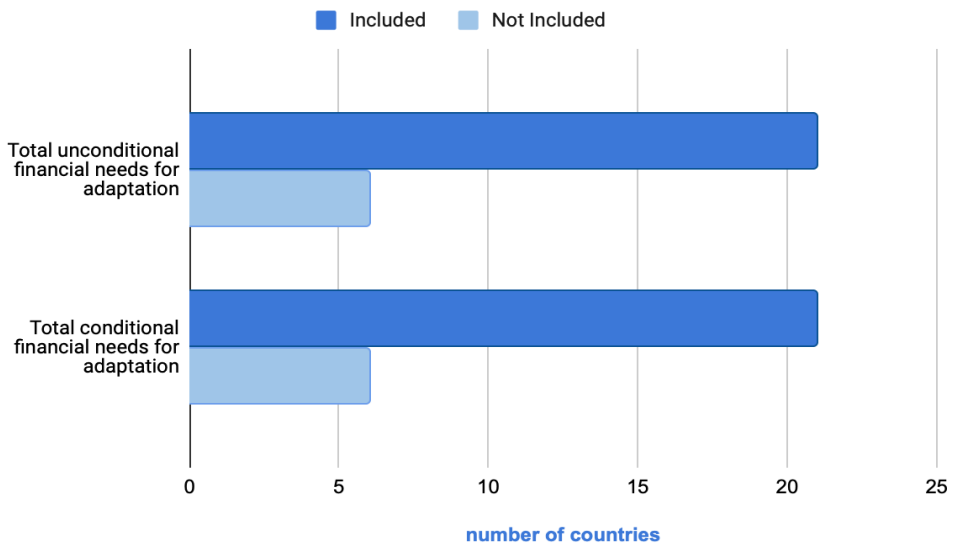


Figure 6: Element of communication on Identifying financial needs for implementing adaptation priorities.

Source: Author

Furthermore, adaptation finance needs may be reported at the project or at the sectoral level rather than the total adaptation cost. The analysis found that where sectoral or thematic breakdowns are provided, the estimates were based on sector, program, project, or activity-based costing methods (UNFCCC, 2022a). These costing methods usually assess adaptation options and the costs of implementing these at different levels (Guzmán et al., 2022).

Seventeen of the assessed NDCs used these methods, and a few countries have used results from analytical studies to identify priorities for costing. The latter is considered good practice as it provides information that supports adaptation investment planning and implementation (Halimanjaya et al., 2021a). As indicated above, Angola, Gambia, Namibia, Rwanda, and Seychelles took a step further by providing cost breakdowns of their adaptation finance needs based on sectoral activities. The study also found that targeted interventions effectively address the complex challenges of climate change and help accelerate adaptation action.

5.4 Implementation of Adaptation actions and plans

A few of the assessed NDCs discussed barriers, challenges, and gaps found during their adaptation planning processes, particularly in computing adaptation financial needs. Financing such exercises remains the main challenge for governments when processing NDCs; the layout of financing plans is still lacking, and many funding mechanisms are still unknown to those responsible for implementing NDCs (UNFCCC, 2020; AfDB, 2021; Guzmán et al., 2022). In the case of Angola, the main barrier to establishing adaptation finance needs is the procedural delay and high costs associated with updating or reviewing the existing and subsequent costs for the adaptation measures (Republic of Angola, 2021). Angola also found gaps in technical knowledge in preparing projects, plans, and programs, which directly affects the adaptation finance needs established in NDCs.

Figure 6 indicates that only 4 of the selected NDCs provided good practices that could be helpful and have valuable insights for other developing countries. Zambia suggested applying a multisectoral institutional framework for coordinating climate change and handling cross-cutting issues. Uganda embraced a whole-of-society involvement that encourages society to fully participate in a bottom-up adaptation costing. Uganda also provided lessons learned, such as how the simultaneous work on NDC update and long-term development promoted efficient strategic planning. Furthermore, they found that joint modelling allowed for information sharing and propelled synergies.

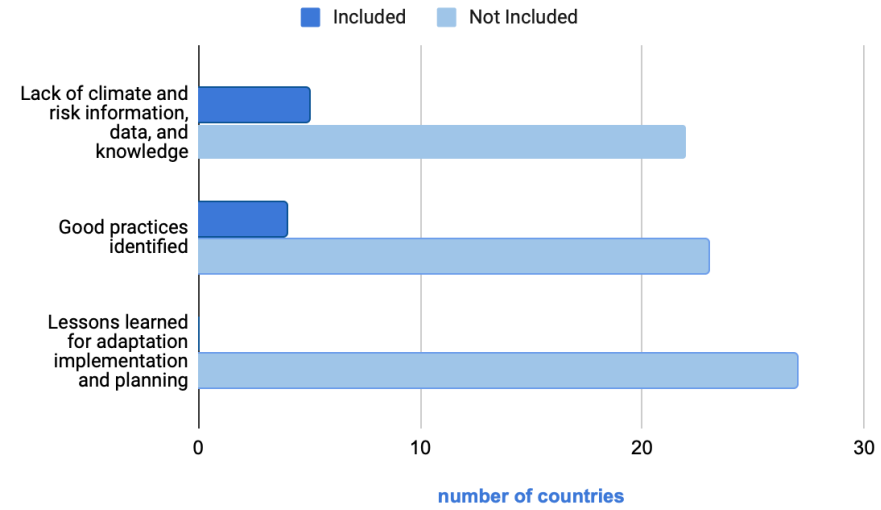


Figure 7: Element of communication on Implementation of Adaptation actions and plans.

Source: Author

Other countries, such as Eswatini and Ethiopia, pointed out the need to redefine definitions of adaptation costs to ensure accuracy, accountability, and transparency in determining adaptation finance needs. For Guinea-Bissau, the issue is whether past, current, and pipeline projects can meet the country's adaptation needs. Their NDC also indicated the lack of data that can assist Guinea-Bissau in articulating its financial needs to external parties. Overall, many of the NDCs indicate strong government-centred adaptation actions, with little to no ownership and coordination of the society.

5.5 Summary of Findings

Reflecting on the research questions, this research aimed to assess the robustness of processes and methodologies used to determine the adaptation finance needs in NDCs. The purpose was to obtain a deeper understanding of the process's countries have gone through to produce their costs to adapt to climate change. A comparative analysis was employed to ensure that the research is comprehensive and looks at the various ways of calculating financial needs. An evaluation framework from the WRI was adopted to determine the robustness of processes. This framework was applied to the information extracted from NDCs submitted by the selected countries under review. As indicated above, a set of questions linked to the elements of communication was used as a guide to assess the robustness of the processes. *Figure 7* below summarises the synthesised results from the above sections to present the overall assessment as either comprehensive or reasonable. The results in

Figure 7 also take into consideration the outcome from the NDC attribute Table 3 to ensure that the results are comprehensive.

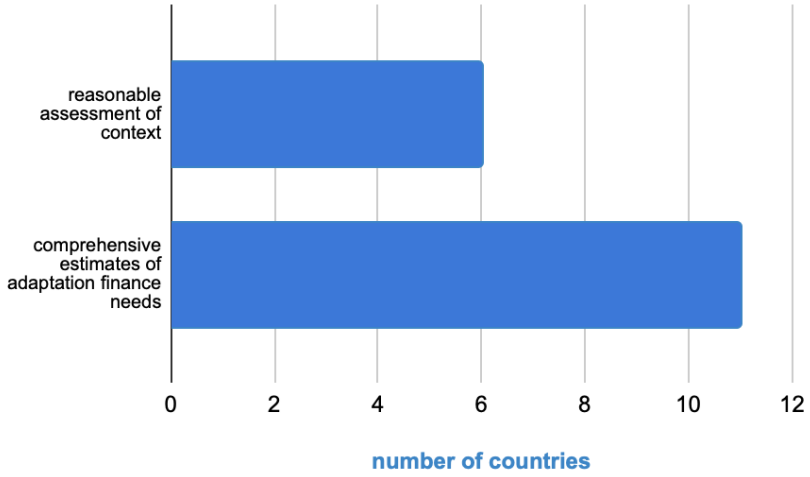


Figure 8: Summary of results

Source: Author

The following Chapter concludes the thesis, following the findings from the assessment of the adaptation component of African NDCs. The Chapter will also discuss and provide suggestions for future research on the topic.

Chapter 6: Conclusion

This Chapter highlights the main findings of this thesis in exploring its research questions and objectives. It then offers concluding remarks on the thesis and recommendations for future research. The thesis aimed to assess and compare the methodologies and processes used to estimate adaptation finance needs in NDCs. The research reviewed relevant literature on the main themes, outlined the methodology used for the analysis, and introduced the framework for the assessment. The results consisted of the individual NDC analyses, which were synthesized using the guidance of research questions and the assessment framework.

6.1 Synthesis of Findings

The research questions outlined in Chapter 1 seek 'to identify the processes and methods used to determine financial needs in NDCs; assessing their robustness and the extent to which they are described in NDCs.' This section presents the synthesis of the NDC analysis in response to each research question.

Question I: What processes and methods are used to determine adaptation financial needs in NDCs?

The research found that 18 of the 27 selected African countries assessed adaptation costs and reported these in NDCs. However, only eleven provided detailed and comprehensive estimates of adaptation costs, including the breakdown of conditional measures that require external financial support to be implemented—known as the '*adaptation finance needs*. As discussed in Chapter 4, a detailed and comprehensive estimate should be granular and include sector-specific information, look-up tables or inventories such as costs, cost-effectiveness, cost-benefit ratios, and cost benchmarking information. This is easily achieved through sector, program, project, or activity-based costing methods. Hence, the research used this as a grading criterion for information on adaptation finance needs.

The research also assessed the experience of developing countries in estimating adaptation costs, and it found a wide range in the level of detail of the estimates submitted in NDCs. The lack of conventional reporting standards influenced the granularity of these assessments across different countries. Table 3 provides an overview of how each country describes its adaptation financial needs. Liberia, Malawi, and Rwanda had the highest average scores for detail and granularity of information provided in their NDCs. Furthermore, the research acknowledged the complexity of costing adaptation measures and the lack of universal methods for assessing adaptation costs. This indicates that developing countries find the estimation of adaptation costs challenging or do not have the time, resources, or expertise to undertake such assessments.

The absence of a universal method for assessing adaptation costs means various methods can be used. However, the literature review only found ten methods that countries could have used to determine their adaptation finance needs. These methods address the challenges of estimating adaptation costs by adopting different assumptions and alternative framing to suit each country's needs. The research

also established that there is no single, definitive cost of adaptation for a country. The costs depend on the method used, the objectives set, and the assumptions made, noting different stakeholders' perceptions of climate change adaptation.

The analysis also found that eight countries used sector, program, or project-based costing to estimate these costs. Some provided thematic breakdowns within the sectoral estimates, which gives a holistic view of their financial needs. The categorization helped in cases where countries did not explicitly state the process and methods used to reach the figures reported. Nevertheless, the research found that 90 percent of the countries implemented more than one process for their cost calculations, with the popular processes being project-based costing and stakeholder consultations on costs to implement adaptation measures.

Question II: How effective/robust are the processes and methods in determining adaptation financial needs?

A qualitative assessment framework was applied to the information extracted from NDCs to determine the robustness of the processes and methods in determining financial needs. The information evaluated national circumstances, assessment of expected impacts, risks, vulnerability, and the adaptive capacity for all key sectors. The assessment found that none of the NDCs meets all four elements of communication indicated in the framework. Most countries had three elements: the "National Circumstances, Institutional arrangements, and Legal frameworks; Impacts, Risks, and Vulnerability; and Identifying Financial needs for implementing adaptation priorities" (Dixit et al., 2022:23-26). Implementing adaptation actions and plans that discuss barriers, challenges, and gaps found during their adaptation planning processes, particularly in computing adaptation financial needs, was the least discussed element. Ninety percent of the countries also could not demonstrate good practices or lessons learned.

The comparative analysis established that 21 countries provided detailed information on their adaptation component's planning and coordination processes. These countries consulted more government agencies, ministries, and stakeholder groups to develop adaptation components and determine their financial needs. Information on the impact, risk, and vulnerability to climate change was described in only ten NDCs; the remaining countries left out this communication element. It was also found that countries with institutional arrangements and reports on national circumstances could effortlessly draw on the latest vulnerability and impact information to develop their adaptation costs in their NDCs. This information reflects a fair idea of the adaptation needs of a country and, subsequently, a more accurate financial need.

Lastly, 21 NDCs identified their adaptation costs; however, only 18 countries' financial needs disaggregated conditional measures from unconditional adaptation measures.

Here, countries determined finance needs referring to their existing adaptation costs and incremental financing requirements. In some NDCs, adaptation finance needs were reported only for prioritized adaptation actions or specific sectors rather than the total adaptation costs. The synthesis found that even though countries gave more attention to some elements of the assessment framework used in this analysis. It does not mean these elements were adequately addressed.

Question III: To what extent are the processes and methods described in NDCs?

The extent to which processes and methods of cost estimations for adaptation needs are described in NDCs varied significantly from one NDC to another. Some countries with robust data collection systems and historical climate information were better equipped to provide detailed references to the processes and methods used. In contrast, countries with limitations faced more significant challenges in providing detailed descriptions; a few presented no information on processes for estimating adaptation finance needs. As indicated in Chapter 4, only three countries had well-described NDC attributes, while 14 mentioned certain elements but needed more detail. Ten countries did not describe the characteristics of communication that the thesis assessed.

The synthesis found that methodological inconsistencies from similar processes and cost estimation methods across NDCs contributed to the variations in the level of detail provided. However, these methods were tailored to each country's needs; therefore, it is inevitable that such variances will be found. Apart from the availability of data and the specific approach taken, capacity and lack of experts also contributed to the variations in the comprehensiveness, accuracy, and transparency of these processes and methods.

6.2 Recommendations

Although many countries have made significant progress in reporting adaptation finance needs, some areas need additional work. Recommendations for reporting on the processes and methods used to determine adaptation financial needs in NDCs include providing a clear and comprehensive accounting of costing methods to facilitate transparency, accountability, and informed decision-making. Taking this step ensures that adaptation actions are implemented effectively and on time. This is also critical for raising finance and addressing fund gaps experienced by developing countries.

Furthermore, developing cost methodologies that integrate adaptation into national budgets could align with other ongoing initiatives to develop robust estimates. This is important for creating realistic and attainable NDC plans. Also, the UNFCCC must advance its guidance and provide supporting material; this would be useful and help countries report costs in their NDCs. Supporting material could include benchmarking estimates, templates for compiling costs, and good practices. This could also include regional contextual advice in critical areas where current practice is low.

Lastly, future research can focus on the different methods for assessing financial needs and identify best practices and their applicability in various sectors.

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APPENDIX A: FRAMEWORK FOR ASSESSING THE ADAPTATION COMPONENTS OF NDCS

Element of Communication	Main Question:	Sub Question:	Additional Notes	Relevancy to determining adaptation finance needs
National circumstances, institutional arrangements, and legal frameworks	Does the Nationally Determined Contribution (NDC) describe the adaptation planning process and the NDC development planning process?	Description of the planning process for NDC development	- Institution leading the NDC development, stakeholders involved (civil society organisation, private sector, academia, technical bodies), timeline.	For countries to successfully implement their Nationally Determined Contributions (NDCs), they need inclusive planning processes that involve those responsible for NDC financing and implementation in vision-setting and prioritization, planning, and coordination. Multi-stakeholder engagement has many benefits, including: • Improved mainstreaming of climate action into national and sectoral plans and budgets; • Consideration of the priorities of diverse stakeholders to increase buy-in and maximize benefits; • Identification and commitment of domestic, international, and private finance; and • Increased ownership of climate plans by the national government and local actors.
		Description of the planning process for adaptation planning	- Institution leading the adaptation planning, stakeholders involved (civil society organisations, private sector, academia, technical bodies), timeline, multistakeholder processes, primarily aligned with the NDC development process. If there is a reference to plans (and not existing plans), limit answers to national adaptation plan (NAP) or national climate change strategy.	
	Is there a description of institutional arrangements to enhance coordination (sectors, other processes, national development, etc.), planning, and implementation?	Description of coordination process for adaptation planning.	- Lead body identified for coordinating adaptation planning, evidence of vertical coordination (national to local), evidence of horizontal coordination (across sectors and ministries); this question is looking at how they set up the institutional structure to set up the national plan	
		Description of coordination process with other development or climate change processes	- Lead body identified for coordinating other processes, evidence of alignment of adaptation planning with other processes (explicit links to other national or sectoral development plans, policies, and programs)	
Impacts, risks, and vulnerabilities	Does the NDC include short-, medium-, and long-term trends for changes in the climate?	Short- and/or medium-term trends in climate change.	- 2030–50: Temperature (hot and cold days, high temperature), precipitation (rainfall), sea level rise, extreme events, and other impacts (floods and droughts); they may note differences in regions/geographic areas.	Countries must establish vulnerability or resilience baselines to assess the social and economic costs of climate risk, and then integrate prioritized adaptation actions into the NDC investment planning process. When implemented together, these activities help countries identify the tools and approaches necessary to prepare for and respond to the extreme impacts of climate change cost-effectively. Assessment and identification of adaptation needs, through the development of quantifiable baselines, helps to develop climate modelling and scenarios, and improve the accessibility of risk data—activities that identify key intervention areas which inform later stages of investment planning and cost estimations for adaptation options.
		Long-term trends in climate change	2100 and beyond: Temperature (hot and cold days, high temperature), precipitation (rainfall and drought), sea level rise, extreme events, and other impacts (floods and droughts); they may note differences in regions/geographic areas.	
	Does the NDC include information about the impact of climate change on specific sectors/systems?	Physical climate change impacts on sectors/ systems	If the NDC provides its sectoral categorisations, use ones in NDC	

		Vulnerabilities and risks for specific population groups	- Look for references to groups such as children, elderly, poor, rural small-scale farmers, informal labourers, etc.	
Implementation and support needs of, and provision of support to, developing-country parties	Does the NDC identify financial needs for implementing identified adaptation priorities?	Total unconditional financial needs for adaptation	- Unconditional here implies that the country would implement actions regardless of the availability of financial resources. If an NDC has an adaptation component but only has financial figures for both adaptation and mitigation and does not identify adaptation-specific numbers, do not include general funding figures here.	While the NDCs typically identify broad adaptation-related priorities, the level of detail remains limited thereby making it difficult to translate such priorities into a direct investment pipeline. In order to access finance, countries need clear project concepts as a minimum, and financing propositions need to be developed. It is crucial to identify the level and type of support needed to address each funding gap. Therefore, countries can assess the amount and type of support required for each action plan and the likely type of funding source (e.g. government, bilateral and multilateral funders and private sector). Finance institutions reiterated that the financing gaps are less associated with the availability of funding but more related to financial resource access, especially in developing countries
		Total conditional financial needs for adaptation	- Conditional implies a country would only implement these actions in the event of finances available for them; if costs are high and it is unclear that they are un/conditional, assume that the country will require additional/external financing.	
Implementation of adaptation actions and plans	Does the NDC identify barriers, challenges, and gaps related to implementing adaptation?	Lack of climate and risk information, data, and knowledge	- These questions are general discussions about barriers/challenges/gaps	Providing the best practices and lessons learnt in the adaptation development process could provide helpful insights and inputs into the ongoing work. It may benefit other nations from information on lessons learned and possible best practices established by others. It also enables UNFCCC to perform a stocktake on the existing financing gaps in developing countries while creating a platform to address those gaps, and also help promote adaptation implementation.
	Does the NDC identify good practices and lessons learned?	Good practices identified.	- This answer will need to demonstrate "how to" practice good adaptation, not just about achievements.	
		Lessons learned for adaptation implementation and planning.	- Identify any lessons learned around adaptation planning, implementation, and/or monitoring, evaluation, and learning (MEL) identified in the NDC; include concrete lessons where available.	

Source: Dixit et al. (2022)