GREENBOOK
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RAY NKONYENI MUNICIPALITY

Ray Nkonyeni Local Municipality Adaptation Action Plan

AUGUST 2024

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List of Acronyms and Abbreviations

CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFFE	Department of Forestry, Fisheries and the Environment
DHS	Department of Human Settlements
DRR	Disaster risk reduction
HDA	Housing Development Agency
IPCC	Intergovernmental Panel on Climate Change
LRT	Let's Respond Toolkit
PHSHDA	Priority Human Settlement and Housing Development Area
PHS	Priority Human Settlement
PHDA	Priority Housing Development Area
PLM	Ray Nkonyeni Local Municipality
SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

Glossary of Terms

Adaptation actions	A range of planning and design actions that can be taken by local government to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development (CSIR, 2019).
Adaptation planning	The process of using the basis of spatial planning to shape built-up and natural areas to be resilient to the impacts of climate change, to realise co-benefits for long-term sustainable development, and to address the root causes of vulnerability and exposure to risk. Adaptation planning assumes climate change as an important factor while addressing developmental concerns, such as the complexity of rapidly growing urban areas, and considers the uncertainty associated with the impacts of climate change in such areas – thereby contributing to the transformational adaptation of urban spaces. Adaptation planning also provides opportunities to climate proof urban infrastructure, reduce vulnerability and exploit opportunities for sustainable development (National Treasury, 2018; Pieterse, 2020).
Adaptive capacity	"The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC, 2022, p. 2899).
Climate change adaptation	"In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2022, p. 2898).
Climate change mitigation	"A human intervention to reduce emissions, or enhance the sinks, of greenhouse gases (GHGs)" (IPCC, 2022, p. 2915). The goal of climate change mitigation is to achieve a reduction of emissions that will limit global warming to between 1.5°C and 2°C above preindustrial levels (Behsudi, A, 2021).

Climate hazards	Climate hazards are a sub-set of natural hazards and a grouping of hydrological, climatological, and meteorological hazards. This includes the spatial extent and frequency of, among others, floods, fires, and extreme weather events such as extreme rainfall and extreme heat. Sometimes referred to as hydrometeorological hazards. The potential occurrence of a climate hazard may cause loss of life, injury, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (IPCC, 2022). Climate hazards can increase in intensity and frequency with climate change (Pieterse et al., 2023).
Climate risk	Risk implies the potential for adverse consequences resulting from the interaction of vulnerability, exposure, and a hazard. Relevant adverse consequences include those on "lives and livelihoods, health and well-being, economic and sociocultural assets, infrastructure and ecosystems" (IPCC, 2022, p. 144). In the IPCC's 6th Assessment Report, it is confirmed that risks may result from "dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system" (IPCC, 2022, p. 132).
Coping capacity	"The ability of people, institutions, organizations and systems, using available skills, values, beliefs, resources and opportunities, to address, manage, and overcome adverse conditions in the short to medium term" (IPCC, 2022, p. 2904).
Disaster risk reduction	"Denotes both a policy goal or objective, as well as the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard or vulnerability; and improving resilience" (IPCC, 2022, p. 2906).
Exposure	Exposure implies the physical exposure of elements to a climate hazard. It is defined as the "presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected [by climate hazards]" (IPCC, 2022, p. 2908).
Mainstreaming	The process of integrating climate change adaptation strategies and measures into existing planning instruments and processes as opposed to developing dedicated adaptation policies and plans (Pieterse et al., 2021).

Resilience	"The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation" (IPCC, 2022, pp. 2920–2921).
Sensitivity	"The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)" (IPCC, 2022, p. 2922).
Vulnerability	Vulnerability is defined as the "propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including, sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (IPCC, 2022, p. 2927). Vulnerability refers to the characteristics or attributes of exposed elements, i.e., elements that are exposed to potential climate-related hazards. Vulnerability is a function of sensitivity and (coping or adaptive) capacity (Pieterse et al., 2023).

1. Introduction

Climate change impacts vary widely from region to region in South Africa, and are reflected by floods, droughts, heatwaves, and coastal erosion, among others. These impacts directly threaten life, economic well-being, property, infrastructure, and ecosystems as well as the ability of local government to provide public services. It is local government's responsibility and duty to provide leadership in planning and preparing to manage these risks for the sake of the well-being, safety, and security of individuals within their jurisdiction (SABS, 2023). The purpose of this document is to strengthen the capability of local government to prepare for climate change threats and associated risks.

The Climate Change Adaptation Plan and its accompanying Risk Profile report have been specifically drafted for the Ray Nkonyeni Local Municipality (RNLM) with the aim of strengthening its strategic response to climate change. These documents derive their insights from the GreenBook (www.greenbook.co.za), a freely accessible online planning support system. The GreenBook is a unique and invaluable resource, providing quantitative scientific evidence to assist local governments in comprehending their climate risks. It plays a pivotal role in guiding the adaptation of settlements to withstand the impacts of both current and future climate challenges.

Designed as an information-rich tool, the GreenBook caters to South African local governments, offering insights into risks and vulnerabilities associated with population growth, climate change, exposure to hazards, and the vulnerability of critical resources. Moreover, the GreenBook not only diagnoses these challenges but also provides practical adaptation measures. These measures are essential for cities, towns, and settlements, empowering local government to mitigate the impacts of climate hazards on communities, the environment, the economy, and municipal assets and infrastructure, while aligning with broader developmental goals (refer to Green Book l Adapting settlements for the future).

The Climate Risk Profile and the Climate Change Adaptation Plan serve distinct yet interlinked purposes and strategic objectives. They aim to:

1. Drive and advance the local climate change response agenda.
2. Provide a foundational framework for strategy and planning within the Local Municipality, with a specific focus on Priority Human Settlements or Priority Housing Development Areas (PHSDAs).
3. Systematically identify and prioritise risks and vulnerabilities.
4. Pinpoint and prioritise targeted interventions and responses.
5. Facilitate the integration of climate change response, particularly adaptation, into mainstream policies and practices.

In essence, these documents are instrumental in equipping Ray Nkonyeni Local Municipality with a comprehensive strategy to navigate the complexities of climate change, reduce vulnerability and exposure, and champion sustainable development.

The Adaptation Action Plan briefly outlines the policies constituting the framework for adaptation in South Africa. It then goes on to describe generic adaptation principles, approaches, pathways, and various categories of actions. Subsequently, the plan suggests a specific adaptation strategy for Ray Nkonyeni LM by aligning it with adaptation goals, programmes, and actions designed to address priority risks. Finally, the document concludes with recommendations aimed at facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

2. Policy Framework

South Africa's institutional policy and legislative framework makes provision for climate change adaptation at all levels of government, with local government increasingly identified as the primary driver of climate change adaptation. For instance, there exists various national policy and legislative mechanisms that promote, necessitate, guide and/or regulate climate change adaptation at the local level. These include the Disaster Management Amendment Act, i.e., Act No. 16 of 2015, the Spatial Planning and Land Use Management Act (SPLUMA), i.e., Act No. 16 of 2013, the Climate Change Bill (B9 of 2022), the 2011 National Climate Change Response White Paper, as well as the 2019 National Climate Change Adaptation Strategy.

While the Disaster Management Amendment Act requires each organ of state, as well as provincial and local government to identify measures for, as well as indicate plans to invest in, disaster risk reduction (DRR) and climate change adaptation; SPLUMA identifies the principles of (1) spatial resilience – which involves accommodating "flexibility in spatial plans, policies and land use management systems, to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks" (Republic of South Africa., 2013, p. 20) – some of which may be induced by the impacts of climate change, and (2) spatial sustainability, which sets out requirements for municipal planning functions such as spatial planning and land use management to be carried out in ways that consider protecting vital ecosystem features such as agricultural land, i.e., from both anthropogenic and natural threats, including the impacts of climate change, as well as in ways that consider current and future costs of providing infrastructure and social services in certain areas (e.g., uninformed municipal investments may lead to an increase in the exposure of people and valuable assets to extreme climate hazards) amongst the key principles intended to guide municipal planning and development. The Climate Change Bill (DEA, 2018) sets out requirements for every District Intergovernmental Forum to serve as a Municipal Forum on climate change that coordinates climate response actions and activities in its respective municipality, while also requiring every municipality to report on their climate change response needs and draft resultant climate risk assessments, as well as climate change response and -implementation plans.

Moreover, the National Climate Change Response White Paper identifies local governments as critical role players that can contribute towards effective climate change adaptation through their various functions, including human settlement planning; urban development; municipal infrastructure and services provision; water and energy demand management; and local disaster response, amongst others. The National Climate Change Adaptation Strategy (DEA, 2019) outlines several actions that are applicable at local government level, including the development and implementation of adaptation strategies and vulnerability reduction programmes for communities and individuals that are most at risk to the impacts of climate change; the development of municipal early warning systems; as well as the integration of climate change adaptation into municipal development plans and relevant sector plans.

In response to the national call to advance spatial transformation and consolidation in human settlement development, the National Department of Human Settlements (DHS) has identified and gazetted a total of 136 Priority Human Settlements and Housing Development Areas (PHSHDAs). The PHSHDAs were declared to ensure that housing delivery is used to restructure and revitalise towns and cities, strengthen the livelihood prospects of households, and overcome apartheid spatial patterns by fostering integrated urban forms (DHS, 2020). PHSHDAs were designated using national criteria which includes an area or settlement's potential to support sustainable environmental management (which plays a critical role in mitigating the negative impacts of climate change, particularly through nature-based adaptation

solutions), as well as its potential to accommodate the integration of land uses and amenities, i.e., in addition to other criteria.

The DHS has identified two key objectives for PHSHDAs, including (1) targeting and prioritising areas for integrated housing and human settlements development to ensure the delivery of housing for a diverse range of income groups within an integrated mixed-use development, as well as (2) transforming spatial patterns which have historically exacerbated social inequality and economic inefficiency (PLM, 2021). As part of the second objective, this initiative aims to develop post-apartheid cities and city patterns that ensure urban access, as well as achieve a balance between spatial equity, economic competitiveness and environment sustainability (PLM, 2021). As the impacts of climate change become more severe, the latter outcome (i.e., ensuring and maintaining environmental sustainability) will become increasingly important.

Furthermore, as part of the implementation approach for housing and human settlement development in PHSHDAs, the DHS has identified the provision and maintenance of ecological infrastructure to support development in priority areas as a key avenue for integrating climate considerations and mainstreaming climate responses, including climate change adaptation.

3. Adaptation Principles, Approach, Programmes & Actions

Climate change mitigation and adaptation refer to the two primary strategies aimed at addressing the adverse effects of climate change, i.e., by either delaying, reducing, redistributing, or avoiding the impacts. Although disaster risk reduction and climate change mitigation form part of the overall climate change response agenda, the focus of this plan is on adaptation.

Climate change adaptation aims to reduce climate-related risks by adjusting a system to the actual or anticipated climate and seeking "to moderate or avoid harm [and] exploit beneficial opportunities" (IPCC, 2022, p. 2898) that may derive from unavoidable impacts of climate change such as extreme hazards. The climate change adaptation agenda is concerned with adapting species, people, places, assets, and systems, to the impacts of actual or anticipated climate-related risks and implements various measures or actions to achieve this (Behsudi, 2021; C40, 2020).

This section of the report outlines adaptation principles, drawing from the recommendations by the South African Bureau of Standards. It also presents a structured approach to selecting adaptation options, categorises adaptation actions, and explains the concept of an adaptation pathway.

3.1. Adaptation principles

The Bureau for Standards recently proposed the following principles that apply to local government when adapting to climate change (SABS, 2023):

i. Accountability: Local governments not only acknowledge but also assume responsibility for their climate change adaptation efforts. They willingly subject themselves to appropriate scrutiny and accept the duty to respond to this scrutiny.

ii. Continual learning and improvement: Recognising the uncertainties in knowledge and the dynamic nature of drivers of change, available knowledge and evidence, and the contextual factors, continual learning and improvement are essential for effective climate change adaptation.
iii. Mainstreaming and embedding: The effectiveness of climate change adaptation is maximised when integrated into local government operations, encompassing policies, plans, procedures, risk management, and implementation strategies.
iv. Flexibility: Embrace a flexible approach that considers technical, social, administrative, political, legal, environmental, and economic circumstances. This allows for the accommodation of a diverse range of data availabilities and technical and institutional capacities to meet goals and objectives.
v. Practicality: Set practical and achievable goals and objectives. Impractical targets may hinder the successful realisation of climate change adaptation benefits. Focus on easily measurable indicators/metrics with available underlying data and compare them across scales to avoid imposing additional burdens.
vi. Prioritisation: During the identification of adaptation plans and measures, prioritise areas based on the relative characteristics of climate change impacts (magnitude, likelihood, and urgency). Consider the capacities of stakeholders and the local government and community's ability to act.
vii. Proportionality: Undertake actions that are most effective under the current circumstances, including economic, social, cultural, and political contexts, capabilities, knowledge, and evidence base. Aspire for continual improvement in identifying and assessing adaptation measures.
viii. Relevance: Facilitate assessments that provide decision-makers and practitioners with meaningful information for adaptation planning, considering appropriate spatial scales and relevant time durations.
ix. Transparency: Ensure that reports and communications on climate change adaptation are openly, comprehensively, and understandably presented, providing accessible information for all interested parties (SABS, 2023).

These principles should be considered when formulating adaptation goals, programmes, and measures.

3.2. Adaptation approach

The approach that was followed to develop this adaptation plan revolves around comprehending the climate-related risks and implementing adaptive measures in response to these risks. Climate-related risk encompasses the potential for adverse consequences arising from the interplay of vulnerability, exposure, and the occurrence of climate hazards (IPCC, 2022). The components of risk are dynamic, with the occurrence of climate hazards influenced by both natural climate variability and anthropogenic climate change. The exposure of individuals, the built environment, and the natural surroundings to climate hazards is driven by both planned and unplanned development and growth. Vulnerability is the inherent characteristics that make systems sensitive to the effects and impacts of climate hazards.

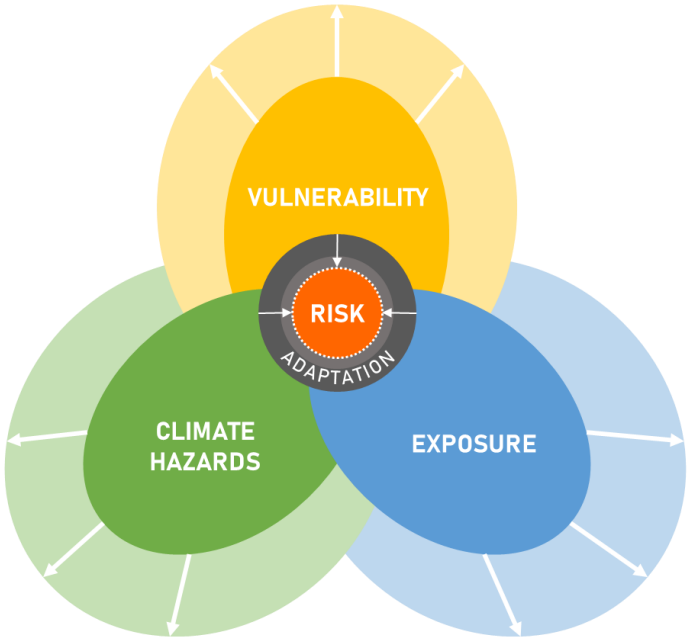

Figure 1 – The interplay between climate hazards, vulnerability and exposure that determines risk (based on IPCC, 2014 and IPCC, 2021)

The inherent uncertainty in future climate trends underscores the necessity for a flexible response and the formulation of adaptable, medium to long-term adaptation strategies.

The approach followed in this plan involves the following steps:

i. Gain an understanding of climate risk in a specific geographic area.
ii. Identify priority climate hazards/zones based on the risk profile.
iii. Establish adaptation goals to mitigate the risk associated with priority hazards/zones.
iv. Develop adaptation programmes with measures/actions to achieve these goals.
v. Integrate climate considerations into other sector plans/instruments/strategies.

Refer to Table 1 for a more detailed description of this approach.

Table 1: The adaptation approach

Understand climate risk for a specific geographic area	A climate risk profile assesses risk by determining – in a specific geographic area and at a specific scale – the likelihood of a hazard to occur, the inherent vulnerability of various systems, and exposure of these systems to specific climate hazards. To be able to develop an appropriate adaptation plan, it is important to understand what contributes to risk and vulnerability.
Identify priority climate-related risks/zones	Identify the climate hazards and impacts that pose the greatest risk at present and in the future within a geographic area. If possible, also identify climate risk zones that need to be prioritised for intervention.

Establish adaptation goals	Identify adaptation goals to address priority risks/zones that speak to policy goals.
Develop adaptation programmes and actions	Develop adaptation programmes that speak to the identified adaptation goals and identify appropriate adaptation actions under each of the programmes that are mutually supportive. Adaptation actions should: • Be specific to a climate hazard/vulnerability/exposure. • Suggest a target or an indicator to measure progress. • Be assignable to a primary implementer. • Consider co-benefits and other possible implications. • Include mitigation as far as it builds resilience or reduces exposure and vulnerability.
Mainstream climate considerations into planning	Integrate evidence of climate risk, adaptation goals, programmes, and actions into existing instruments and processes. The aim is to ensure that climate change considerations are an integral part of all that local government is doing.

The primary aim of an adaptation plan is to address both current and anticipated future risks and vulnerabilities while also leveraging opportunities for long-term transformation and sustainable development.

3.3. Adaptation programmes and actions

An adaptation programme is a structured and systematic set of actions, initiatives, and interventions that can be used to adapt to the impacts of climate change. It involves the practical implementation of specific goals identified in the plan.

Broadly, adaptation actions include anticipatory and reactive measures. Anticipatory adaptation involves proactive measures taken in preparation for anticipated climate change impacts, while reactive adaptation entails responding to climate change effects as they are experienced. Furthermore, it facilitates the integration and prioritisation of climate change adaptation and resilience measures into various planning mechanisms and processes (CSIR, 2019).

A spectrum of adaptation actions is at the disposal of local municipalities to enhance resilience and mitigate risks posed by changing climatic patterns and extreme weather events. Some of the categories of actions include:

- Infrastructure development, encompassing the construction of, for example, seawalls, levees, and storm surge barriers to protect against rising sea levels and extreme weather events. These engineered solutions provide immediate protection and buy time for longer-term adaptation efforts but are mostly very expensive to build.
- Green infrastructure initiatives offer sustainable and nature-based solutions. Municipalities can implement urban green spaces, green roofs, and permeable pavements to absorb excess water, reduce flooding, and mitigate the urban heat island effect. Such approaches not only enhance climate resilience but also contribute to improved air quality and overall urban liveability.

- Environmental protection such as restoring ecosystems like mangroves, dunes, and wetlands, not only provides natural buffers but also supports biodiversity.
- Integrated urban planning is essential to create climate-resilient municipalities. Land-use regulations should be adapted to consider climate risks, prioritising construction practices that enhance resilience. Elevating structures above projected flood- and sea levels and using climate-resilient materials in building design can minimise the impacts of flooding and storm damage.
- Early warning systems and emergency preparedness plans are critical tools to ensure swift responses to extreme weather events, minimising the impact on vulnerable communities.
- Innovative water management strategies are essential for municipalities facing changing precipitation patterns and increasing water scarcity. Diversifying water sources, implementing water efficiency measures, and investing in advanced stormwater management systems contribute to water security and sustainable resource use.
- Engagement and education are pivotal components of successful adaptation strategies. Empowering officials, and residents, to understand and respond to climate risks through awareness campaigns, education programmes, and participatory planning initiatives can enhance local adaptive capacity (CSIR, 2019).

Local governments must embrace a combination of structural, natural, and community-based approaches to build resilience and adaptive capacity, protect vulnerable communities, while ensuring long-term sustainability in the face of evolving climate challenges.

4. Summary of Climate Risk Profile

A Climate Risk Profile Report was prepared by the team, designed to complement this Plan. The comprehensive Climate Risk Profile serves as an essential resource for understanding the risks associated with climate change in Ray Nkonyeni Local Municipality. Presented to representatives of the Municipality during a series of nationwide stakeholder engagements in late 2023, these workshops served as forums to not only validate the risks outlined in the report but also to confirm the adaptation goals proposed.

This section of the Plan summarises the climate risk profile for Ray Nkonyeni Local Municipality, drawing from the GreenBook Risk Profile Tool at https://riskprofiles.greenbook.co.za/. Consult the accompanying Climate Risk Profile Report for more detailed information.

4.1. Climate projections, vulnerabilities and impacts

Climate change projections show that the average annual temperatures across the Ray Nkonyeni LM is anticipated to increase between 1.8°C and 2.1°C in future. These increases will be most pronounced in the interior regions of the local municipality, while smaller increases are expected along the coastline. Under current baseline conditions the area of Port Shepstone has the highest average annual temperatures, ranging between 20°C and 22°C, with an anticipated future rise of around 1.8°C.

Rainfall projections show a general increase across the local municipality with between 55mm and 286mm. The most significant increases in rainfall are expected towards the northern interior part of the local municipality. In future there will be an increase in extreme rainfall days, of between 2.36 days — 5.76 days, especially over the interior parts of the local municipality which is projected to undergo a higher

increase in extreme rainfall events. Similarly, extreme rainfall days are expected to increase from the coast to the inland part with the highest increases in the far west on the border with the uMuziwabantu LM.

Economic vulnerability in Ray Nkonyeni LM is high and ranks 32nd out of the 44 LM's in KZN. The municipality grapples with high levels of unemployment, a significant disparity in income distribution and limited economic diversification. Most of the economic activity is centred around tourism along the coastal strip of the LM. Towns within this coastal zone are all projected to see a high population growth rate. The rural areas of Ray Nkonyeni depend largely on agriculture with many small and subsistence farmers. This high reliance on the tourism and agricultural industry makes the municipality vulnerable to external factors such as climate change, market fluctuations, and seasonal variations in tourist activity.

The population growth expected in Ray Nkonyeni LM will also lead to increased pressure on service delivery and competition for resources. Under current climate conditions, water demand is already higher than water supply. High population growth coupled with increasing temperatures will further increase water supply vulnerability.

4.2. Priority climate-related hazards

Priority climate related hazards in Ray Nkonyeni LM include the increase in the intensity of rainfall, more severe storms and a decline in water availability. Extreme weather events such as storms, tropical cyclones, and heavy rainfall will exacerbate flooding in Ray Nkonyeni LM whereas the coastal region will be more subjected to coastal erosion. This heightened risk increases the vulnerability of communities and infrastructure to future climate impacts.

Flooding and coastal erosion can damage critical infrastructure such as roads, bridges, buildings, and utilities, disrupting transportation networks and essential services. It can also lead to financial losses for property owners, insurance companies, and local governments, as well as displacement of residents and businesses. Coastal erosion and flooding can negatively impact local economies, particularly those reliant on tourism, fishing, and other coastal activities. Damage to beaches, resorts, and fishing infrastructure can result in loss of income for businesses and workers dependent on these industries.

Increased extreme rainfall and flooding is projected for Ray Nkonyeni LM which could impact human health in addition to damaging infrastructure. Flooding events could lead to vector and waterborne diseases, affecting human health. Flooding can contaminate water sources with pathogens, increasing the risk of waterborne diseases such as cholera and gastroenteritis. Residents may be exposed to contaminated water for drinking, cooking, and personal hygiene, leading to outbreaks of infectious diseases. Heavy rainfall and flooding create favourable breeding conditions for mosquitoes and other vectors.

5. Adaptation Goals, Programmes and Actions

The section outlines the adaptation plan using goals and measures designed to help Ray Nkonyeni LM to adapt to the impacts of climate change. Based on the assessment of the potential risks and vulnerabilities posed by climate change, this plan was developed as a proactive strategy to mitigate these risks and enhance resilience.

5.1. Adaptation goals

Drawing upon the assessment of the current and projected climate-related risks and vulnerabilities outlined in the preceding section, the following adaptation goals for Ray Nkonyeni LM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the nationwide engagements:

- Goal 1: To reduce carbon emissions and improve air quality. Reduce greenhouse gas emissions and minimize waste generation to build a sustainable, low-carbon, and resilient community that can adapt to the impacts of climate change. Reducing carbon emissions is crucial for improving air quality and safeguarding public health and the environment.
- Goal 2: To ensure water security and good water quality, protecting water resources under a changing climate. Projected population growth will further strain the district's water supply. Developing comprehensive water resource management strategies is essential to ensure sustainable and equitable access to water for all users (domestic, agricultural, industrial) to secure a sustainable water future.
- Goal 3: To protect and increase the resilience of critical municipal infrastructure. This involves implementing proactive measures that enhance infrastructure design, maintenance, and operational practices, while integrating climate adaptation considerations into infrastructure planning and investment decisions.
- Goal 4: To protect ecosystem health, functionality, and services, while strengthening its capacity to buffer against climate change effects. This involves the conservation and restoration, of natural environments, and biodiversity and investment in green infrastructure.
- Goal 5: To enhance the resilience and sustainability of food systems by implementing strategies that protect urban agricultural land, promote the establishment of food gardens, and support small-scale farmers.

The adaptation programmes below identify the overarching programmes and their actions, necessary to achieve each one of the goals. Specific timeframes and responsibilities are allocated in the subsequent implementation framework.

5.2. Adaptation programme: Goal 1

Goal 1: Reduce carbon emissions and improve air quality.
Programme 1.1: Monitor and enforce regulations to reduce carbon emission.
This programme involves implementing robust monitoring mechanisms, adopting mitigation measures, and promoting sustainable practices across key sectors to contribute to national climate targets and enhance local resilience to climate change.

Actions:

i. Enforce air quality regulations: This action involves the monitoring of industries with air emissions licences to adhere to emissions parameters as set out in the air emissions licences.
ii. Implement community education and awareness: This action involves the education of communities about the importance of not burning waste and making open fires. Burning waste through open fires is a major contributor to climate change and air pollution, making it a harmful practice in these contexts.

iii. Manage and adhere to guidelines for burning sugar cane: Educate the sugar cane farming communities within the municipality about the appropriate times to burn sugar cane to reduce air pollution.
iv. Control and clear alien invasive species: The action includes the identifying, mapping and targeting of high-risk areas with invasive species to lessen the intensity and frequency of wildfires by controlling invasive alien plants that act as fire accelerants.

Programme 1.2: Reduce, reuse, and recycle waste.
This program aims to minimize the environmental impact of waste generation, mitigate greenhouse gas emissions, and promote resource efficiency and circular economy principles.

Actions:
i. Implement waste reduction programs and campaigns: Promote awareness, behaviour change, and sustainable consumption practices among residents, businesses, and institutions, aiming to minimize the generation of waste at the source.
ii. Develop recycling infrastructure: Invest in the development and expansion of recycling infrastructure and systems for recyclable materials such as paper, plastics, glass, and metals, to facilitate separation, collection, and processing of recyclables.

Programme 1.3: Raise community awareness.
Informed communities can make informed decisions, while traditional leaders bring local knowledge and trust, and political leaders have the power to enact necessary policies. This collaborative approach fosters a sense of ownership and empowers communities to become active participants in creating a more sustainable future.

Actions:
- Organise community training workshops: Organize workshops on practical skills like water conservation, sustainable agriculture practices, and disaster preparedness.
- Facilitate knowledge sharing: This involves the organising of workshops where traditional leaders and climate scientists can learn from each other. It also includes the framing of climate change messages around local impacts on livelihoods, health, and cultural practices to resonate with the community.
- Establish community-based early warning systems: Such systems alert residents about impending climate-related hazards, such as floods, storms, and heatwaves. Work with community leaders, local NGOs, and residents to identify local climate risks, gather information and train community members on climate risks, early warning signs, and pre-emptive actions they can take.

5.3. Adaptation programme: Goal 2

Goal 2: To ensure water security and good water quality, protecting water resources under a changing climate.
Programme 2.1: Prevent saltwater intrusion into rivers from the sea.
This program involves the implementation of various measures to ensure that freshwater sources remain usable for drinking water, irrigation, and ecological functions.
Actions:

- Implement coastal protection measures: Measures include seawalls and coastal embankments to prevent seawater intrusion into rivers and estuaries. Strategically placed barriers can help confine freshwater flow and prevent saltwater from entering river channels.
- Establish and maintain natural buffer zones: Establish mangroves, salt marshes, and coastal wetlands along riverbanks and estuarine areas. This could include ensuring that areas along riverbanks and estuaries have proper water flow and salinity levels, planting native wetland vegetation suited to the specific environment, and controlling invasive species that could disrupt the ecosystem.

Programme 2.2: Clear alien invasives species, especially on riverbanks.
This program includes the prioritisation of specific invasive species to be removed, the best methods as well as the ecological restoration activities after clearing and prevent re-invasion by the alien species. Clearing them allows native vegetation to return, which helps stabilise the banks, reduces erosion, and naturally filters pollutants, leading to cleaner and more plentiful water.

Actions:
- Initiate and implement invasive alien plant clearing programs: Target priority areas within water catchment zones, riverbanks, and wetlands.
- Conduct ecological restoration activities following invasive alien plant clearing efforts.
- Engage local communities, stakeholders, and landowners in invasive alien plant clearing initiatives.

Programme 2.3: Drilling boreholes.
Borehole drilling is often most effective as part of a comprehensive water management plan and when combined with other water conservation strategies like rainwater harvesting.

Actions:
- Conduct hydrogeological assessments to identify suitable drilling sites and aquifer characteristics,
- Drill boreholes in strategic locations identified through hydrogeological assessments.
- Implement water quality monitoring programs to track borehole performance, groundwater levels, pumping rates and water quality parameters.

Programme 2.4: Manage stormwater runoff appropriately.
Climate change is bringing more frequent and intense rainfall events, leading to increased stormwater runoff. A key adaptation goal for stormwater runoff management is to upgrade traditional drainage systems to handle increased flow during heavy rain events and mimic natural systems to lessen the burden on traditional drainage systems.

Actions:
- Enforce legal connections to the stormwater system.
- Upgrade stormwater drainage systems, including culverts, channels, and retention ponds, to accommodate increased stormwater runoff resulting from extreme weather events.
- Adopt Water Sensitive Urban Design (WSUD): Adopt water-sensitive urban design principles and practices to integrate stormwater management with urban planning and design, incorporating

features such as water-sensitive streetscapes, green corridors, and sustainable drainage systems to enhance water quality and mitigate urban heat island effects.

5.4. Adaptation programme: Goal 3

Goal 3: To protect and increase the resilience of critical municipal infrastructure.
Programme 3.1: Integrate nature into urban planning.
The programme aims to integrate natural features such as green spaces, urban trees, and green infrastructure into urban planning to enhance the resilience of cities to climate change impacts such as extreme heat, flooding, and storms. Nature-based solutions like green roofs, permeable pavements, and bioswales can help absorb excess rainwater, reduce urban heat island effects, and mitigate flooding. It also enhances public health and well-being by providing opportunities for recreation, exercise, and relaxation. Green spaces, trees, and vegetation in urban areas helps mitigate urban heat island effects by providing shade, reducing surface temperatures, and cooling the surrounding environment.

Actions:

- Advocate for Green Construction techniques and design principles such as the use of natural ventilation, high energy efficiency heating and lighting and rainwater harvesting.
- Promote urban greening: Encourage the creation of green infrastructure like rooftop gardens, bioswales (rain gardens), and planting trees to enhance biodiversity within urban areas.
- Prevent illegal encroachments into the critical coastal zones.

Programme 3.2: Prioritize maintenance, repair, and upgrades of existing municipal infrastructure assets. This will ensure that infrastructure assets can continue to function effectively during and after extreme weather events. It will also reduce downtime and disruptions, while also extending the lifespan of existing infrastructure by adapting it to withstand changing climatic conditions and prevent premature deterioration.

Actions:

- Implement regular inspection, and maintenance programs for stormwater drainage systems, pump stations, culverts, bridges, and roads, including repair of potholes, cleaning of drains, removal of debris and reinforcement of vulnerable areas.
- Develop rehabilitation projects to address aging infrastructure and infrastructure deterioration.
- Develop and implement emergency response plans and procedures for stormwater and road infrastructure management during extreme weather events

5.5. Adaptation programme: Goal 4

Goal 4: To protect ecosystem health, functionality, and services, while strengthening its capacity to buffer against climate change effects.

Programme 4.1: Conserve, protect and restore natural open spaces, ecosystems and natural resources.
The programme aims to preserve and restore healthy ecosystems which are essential for effective flood management, drought resilience, and sustainable water provision. Conservation efforts and integrated watershed management approaches are critical for ensuring the continued functioning of these ecosystems and the services they provide.

- Enforce environmental regulations: Effectively enforce existing environmental regulations to prevent illegal activities like illegal dumping, illegal wood harvesting, poaching and general overexploitation of natural resources.
- Collaboration between departments: Encourage collaboration between environmental, health, water, and planning departments to ensure holistic enforcement of environmental laws.
- Use the existing environmental management/biodiversity framework to identify and prioritize valuable ecosystems to protect.

Programme 4.2: Restoration and rehabilitation of ecosystems
The programme aims to enhance the provision of ecosystem services such as water purification, soil retention, carbon sequestration, and flood regulation. Restoration efforts can help improve water quality, regulate water flow, and enhance groundwater recharge. These efforts contribute to water security by ensuring a reliable and sustainable supply of water for municipalities, particularly in the face of climate variability and increasing water stress.

Actions:

- Develop restoration strategies: Develop comprehensive plans for the restoration of degraded natural areas, focusing on restoring ecological functions and native biodiversity.
- Implement community-based restoration projects: Engage local communities in restoration efforts, fostering a sense of ownership and promoting environmental stewardship.
- Implement rehabilitation initiatives: Undertake initiatives like tree planting, wetland restoration, and stream bank stabilisation to improve the health and functionality of natural spaces.

5.6. Adaptation programme: Goal 5

Programme 5.1: Protect high value and urban agricultural land and promote climate smart agriculture:
This programme aims to enhance the resilience and sustainability of agricultural systems, ensure food security, and support the livelihoods of farmers and rural communities. This programme will also promote sustainable local food economies that support farmers and strengthen community resilience.

Actions:

- Protect high value agricultural land from urban development.
- Integrate urban agriculture considerations into municipal planning: Integrate urban agriculture considerations into policies, urban development plans, and land-use regulations to mainstream sustainable food production, community gardening, and green infrastructure in urban areas.
- Establish and strengthening local food networks: Establish and promote local food networks, cooperatives, and supply chains that connect farmers directly with consumers, restaurants, schools, and institutions to increase access to fresh, locally grown produce.
- Create markets and improve market infrastructure and access for farmers. Support local farmers, fresh produce markets, and food hubs. Invest in the development and improvement of market infrastructure, e.g. storage facilities, cold storage, and transportation networks.
- Provide technical assistance, and capacity-building: Provide small-scale farmers with access to information and tools such as weather forecasts, and agronomic advisories.
- Implement capacity building programs: Strengthen agricultural extension services to empower small-scale farmers with knowledge, skills, and resources to adopt climate-smart agricultural practice.

6. Implementation Framework

The implementation framework summarises the adaptation plan and indicates responsibilities, timeframes, and priorities.

6.1. Implementation framework: Goal 1

Goal 1: Reduce carbon emissions and improve air quality.

Adaptation programme 1.1: Monitor and enforce regulations to reduce carbon emission.				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Ensure that industries with air emissions licences adhere to emissions parameters as set out in the air emissions licences.	Air quality	Ugu DM	Long term	High
ii. Educate communities about the importance of not burning waste and making open fires	Air quality, fire	RNM and Ugu DM	Long term	Medium
iii. Educate the sugar cane farming communities around the RNM about the appropriate times to burn sugar cane to reduce air pollution.	Air quality, fire	RNM and Ugu DM	Long term	Medium
iv. Controlling and clearing alien invasive species in order to prevent wildfires.	Air quality, fire	RNM and Ugu DM	Long term	Medium

Adaptation programme 1.2: Reduce, reuse, and recycle waste				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Implement waste reduction programs and campaigns in schools, communities, and businesses	Environmental degradation	RNM Education and Waste Section	Long term	Medium

ii. Invest in the development and expansion of recycling infrastructure and systems for recyclable materials	Environmental degradation	RNM Environmental Management RNM Waste Section	Long term	High

Adaptation programme 1.3: Community education and awareness				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Organise community training workshops on practical skills like water conservation, sustainable agriculture practices, and disaster preparedness.	Floods, drought, fire	RNM Environmental Management RNM Education and Section	Long term	High
ii. Engage traditional and political leaders in programs and initiatives aimed at adapting to climate change.	Floods, drought, fire, heatwaves	RNM Environmental Management RNM Education and Section	Medium term	Medium
iii. Establish community-based early warning systems to alert residents about impending climate-related hazards.	Floods, storms, heatwaves	RNM Environmental Management	Long term	High

6.2. Implementation framework: Goal 2

Goal 2: To ensure water security and good water quality, protecting water resources under a changing climate.

Adaptation programme 2.1: Prevent saltwater intrusion into rivers from the sea				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Implement coastal protection measures such as seawalls and coastal embankments to prevent seawater intrusion into rivers and estuaries.	Water quality	RNM Technical Services Ugu Water services	Short term	High
ii. Establish and maintain natural buffer zones such as mangroves, salt marshes, and coastal wetlands along riverbanks and estuarine areas	Water quality	RNM Environmental Management RNM Technical Services	Medium term	Medium

Adaptation programme 2.2: Clear alien invasives species				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Initiate and implement invasive alien plant clearing programs targeting priority areas within water catchment zones, riverbanks, and wetlands.	Drought, flooding	RNM Environmental Management RNM Technical Services	Medium term	High
ii. Conduct ecological restoration activities following invasive alien plant clearing efforts.	Drought, flooding	RNM Environmental Management RNM Technical Services	Medium term	Medium
iii. Engage local communities, stakeholders, and landowners in invasive alien plant clearing initiatives.	Drought, flooding	RNM Environmental Management RNM Technical Services	Medium	Medium

Adaptation programme 2.3: Drilling boreholes				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Conduct hydrogeological assessments to identify suitable drilling sites.	Drought	RNM Technical Services Ugu Water services	Short term	High
ii. Drill boreholes in strategic locations identified through hydrogeological assessments.	Drought	RNM Technical Services	Medium term	Medium
iii. Implement water quality monitoring programs.	Drought	Ugu Water services	Long term	Medium

Adaptation programme 2.4: Manage stormwater runoff appropriately				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Enforce legal connections to stormwater system	Floods	RNM Technical Services Ugu Water services	Short term	High
ii. Upgrade stormwater drainage systems, to accommodate increased stormwater runoff	Floods	RNM Environmental Management RNM Technical Services	Medium term	Medium
iii. Adopt water-sensitive urban design principles and practices such as permeable pavements, green roofs and rain gardens to enhance water quality and mitigate urban heat island effects.	Floods	RNM Environmental Management RNM Technical Services	Long term	Medium

6.3. Implementation framework: Goal 3

To protect and increase the resilience of critical municipal infrastructure.

Adaptation programme 3.1: Integrate nature into urban planning.				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Advocate for Green Construction techniques and design principles such as the use of natural ventilation, high energy efficiency heating and lighting and rainwater harvesting,	Drought, flooding, heat	RNM Development Planning Services	Long term	High
ii. Promote urban greening: Encourage the creation of green infrastructure like rooftop gardens, bioswales (rain gardens), and planting trees to enhance biodiversity within urban areas.	Drought, heat	RNM Development Planning Services	Medium term	Medium
iii. Prevent illegal encroachments into the critical coastal zones.	Drought, flooding, heat	RNM Development Planning Services	Long term	Medium

Adaptation programme 3.2: Prioritize maintenance, repair, and upgrades of existing municipal infrastructure assets.				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Implement regular inspection, and maintenance programs for stormwater and road infrastructure.	Flooding	RNM Development Planning Services	Long term	High
ii. Develop rehabilitation projects to address aging infrastructure and infrastructure deterioration.	Flooding	RNM Development Planning Services	Medium term	Medium
iii. Develop and implement emergency response plans and procedures for stormwater and road infrastructure management during extreme weather events	Flooding	RNM Development Planning Services	Medium	Medium

6.4. Implementation framework: Goal 4

To protect ecosystem health, functionality, and services, while strengthening its capacity to buffer against climate change.

Adaptation programme 4.1: Conserve, Protect and Restore Natural Open Spaces, Ecosystems and Natural Resources.				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Effectively enforce existing environmental regulations to prevent illegal activities like deforestation, pollution, and overexploitation of natural resources.	Floods, drought, wildfires	RNM Environmental Management RNM Technical Services	Short term	High
ii. Encourage collaboration between environmental, health, water, and planning departments to ensure holistic enforcement of environmental laws.	Floods, drought, wildfires	RNM Environmental Management RNM Technical Services	Medium term	Medium
iii. Use the existing environmental management/biodiversity framework to identify and prioritize valuable ecosystems to protect.	Floods, drought, wildfires	RNM Environmental Management RNM Technical Services	Medium term	Medium

Adaptation programme 4.2: Restoration and rehabilitation of ecosystems.				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Develop comprehensive plans for the restoration of degraded natural areas, focusing on restoring ecological functions and native biodiversity.	Floods, drought, wildfires	RNM Environmental Management RNM Technical Services	Short term	High
ii. Engage local communities in restoration efforts, fostering a sense of ownership and promoting environmental stewardship.	Floods, drought, wildfires	RNM Environmental Management RNM Technical Services	Medium term	Medium
iii. Undertake initiatives like tree planting, wetland restoration, and stream bank stabilization to improve the health and functionality of natural spaces.	Floods, drought, wildfires	RNM Environmental Management RNM Technical Services	Medium term	Medium

6.5. Adaptation programme: Goal 5

To enhance the resilience and sustainability of food systems in Ray Nkonyeni LM.

Adaptation programme 4.1: Protect high value and urban agricultural land and promote climate smart agriculture				
Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
i. Protect high value agricultural land from urban development.	Flooding, heat stress, drought	RNM Development Planning Services Department of Agriculture and Rural Development	Medium term	High
ii. Integrate urban agriculture considerations into municipal planning policies, urban development plans, and land-use regulations.	Flooding, heat stress, drought	RNM Development Planning Services Department of Agriculture and Rural Development	Medium term	High

iii. Establish and promote local food networks, cooperatives, and supply chains that connect farmers directly with consumers.	Flooding, heat stress, drought	RNM Development Planning Services Department of Agriculture and Rural Development	Medium term	Medium
iv. Create markets and invest in the development and improvement of market infrastructure, e.g. storage facilities, cold storage, and transportation networks.	Flooding, heat stress, drought	RNM Development Planning Services Department of Agriculture and Rural Development	Long term	Medium
v. Provide small-scale farmers with access to information and tools such as weather forecasts, and agronomic advisories.	Flooding, heat stress, drought	RNM Development Planning Services Department of Agriculture and Rural Development	Medium term	High
vi. Implement capacity building programs to empower small-scale farmers with knowledge, skills, and resources to adopt climate-smart agricultural practice.	Flooding, heat stress, drought	RNM Development Planning Services Department of Agriculture and Rural Development	Medium term	High

7. Implications for the PHSHDAs

The Ray Nkonyeni Municipality prioritizes development within and around its human settlements to foster resilient infrastructure, economic stability, public health, social equity, sustainable natural resource management, and vibrant agricultural and tourism sectors. These priorities reflect the municipality's commitment to improving living conditions, promoting inclusive growth, and adapting to environmental challenges.

Some specific development priorities relevant to climate adaptation for the settlements of Gamalakhe, Shelly Beach, Port Shepstone and Margate are:

- To provide sufficient and equitable access to good quality water.
- To manage development to minimise risk, vulnerability and promote sustainability.
- To build resilient communities, promoting sustainable practices, and enhancing adaptive capacity
- To protect biodiversity and manage urban development impacts on natural resources.
- To enhance food security within the municipality.
- To enhance the value of tourism, heritage resources and scenic routes

Climate change predictions indicate a rise in the intensity and frequency of extreme weather events, particularly heavy rainfall and storms. Combined with rapid population growth, this will pose significant threats to the settlements of Gamalakhe, Shelly Beach, Port Shepstone, and Margate. Although average annual rainfall is expected to rise in these areas, water availability is still projected to decrease due to rising temperatures and population growth.

Rising sea levels combined with storm surges will result in more frequent and intense coastal flooding in these areas. This could submerge low-lying regions, destroy infrastructure, and force residents to relocate. The erosion of beaches and dunes—natural barriers that protect against storm surges—will exacerbate the threat of flooding. Additionally, storms with stronger winds and larger waves could severely damage coastal infrastructure. Increased storm activity and erosion can also inflict significant environmental damage toe coastal ecosystems like mangroves and coral reefs, which are crucial for shoreline protection and biodiversity.

These impacts can lead to loss of property and economic disruption in the PHSHDA settlements. Damage to homes and businesses from flooding and erosion can lead to significant economic losses and disrupt tourism, a major source of income for the coastal PHSHDAs in Ray Nkonyeni LM. Increased flooding and erosion can also force people to relocate, disrupting communities and straining social services. Floods can also have health risks and can contaminate water sources, leading to waterborne diseases.

In light of these climate change predictions for the PHSHDAs in Ray Nkonyeni, focused adaptation strategies are essential to support and accomplish the identified development priorities for the PHSHDAs. The adaptation strategies presented in this document have been designed to align with the development priorities and mitigate the identified climate-related risks ensuring that communities are less vulnerable to the impacts of climate change. By implementing the appropriate climate change adaptation strategies settlements can maintain economic stability and growth despite environmental challenges. It supports the construction of resilient infrastructure that can withstand climate shocks, reducing the need for costly repairs and ensuring long-term sustainability. The adaptation strategies in this document also addresses

the need to integrate environmental considerations into urban planning and resource management. It also considers the need to support broader rural development in terms of agriculture, food security and tourism. Climate change adaptation strategies are therefore essential for ensuring that settlements can continue to develop and thrive despite the ongoing challenges posed by climate change.

8. Recommendations for Mainstreaming

Mainstreaming is the process of integrating climate change considerations into existing sectoral plans, other instruments and decision-making processes across various sectors and levels of governance. It involves recognising that climate change impacts and risks cut across multiple sectors and require a holistic approach to address effectively.

Mainstreaming climate change involves several key elements:

- Policy integration: Embedding evidence of climate change, as well as climate change adaptation and mitigation considerations into sectoral policies and strategies, such as those related to disaster risk management, energy, water resources, transportation, and urban planning. This ensures that climate change is not treated as a standalone issue but is instead integrated into broader development agendas.
- Institutional integration: Incorporating climate change responsibilities and expertise within departments. This may involve establishing a dedicated but decentralised climate change unit, as well as fostering collaboration and coordination among departments and relevant external stakeholders. Incorporating climate response outcomes in the KPIs of all relevant departments, will ensure that progress towards climate goals can be tracked and measured.
- Capacity building: Enhancing the knowledge, skills, and capacities of politicians, decision-makers, and practitioners to understand and address climate change effectively. This includes providing training, technical assistance, and access to relevant information and tools, such as the GreenBook. By improving their understanding of climate change and the need for adaptation, these groups can better integrate climate considerations into their work.
- Budgeting and financing: Allocating resources and funding to support climate change adaptation and mitigation activities within existing budgets and financing mechanisms. This may involve reallocating funds from other priorities, leveraging external sources of finance, or integrating climate considerations into budget planning processes.
- Establishing networks and partnerships: Establishing networks and partnerships with civil society organisations, research councils, the private sector, different spheres of government, and other relevant entities could bolster climate adaptation efforts.
- Monitoring and evaluation: Establishing systems for monitoring and evaluating the effectiveness of mainstreaming efforts and tracking progress towards climate-related goals and targets is essential. This helps ensure accountability and facilitates learning and adaptation over time.

Climate change mainstreaming is essential for building resilience and promoting sustainable development in the face of climate change. By integrating climate considerations into decision-making processes and actions across sectors, mainstreaming helps minimise future risks, maximise opportunities for adaptation and mitigation, and enhance overall resilience to climate change impacts.

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