GREENBOOK
adapting settlements for the future

Khâi-Ma Local Municipality Adaptation Action Plan

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Contents

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
KLM	Khâi-Ma Local Municipality
LRT	Let's Respond Toolkit
PHSHDA	Priority Human Settlement and Housing Development Area
PHS	Priority Human Settlement
PHDA	Priority Housing Development Area
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 Khâi-Ma Local Municipality (KLM) 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 | 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 Khâi-Ma 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 Khâi-Ma LM (KLM) 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 governments increasingly identified as the primary drivers 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 of 2015, the Spatial Planning and Land Use Management Act, i.e., Act No. 16 of 2013 (SPLUMA), 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 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 (See Figure 2).

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.

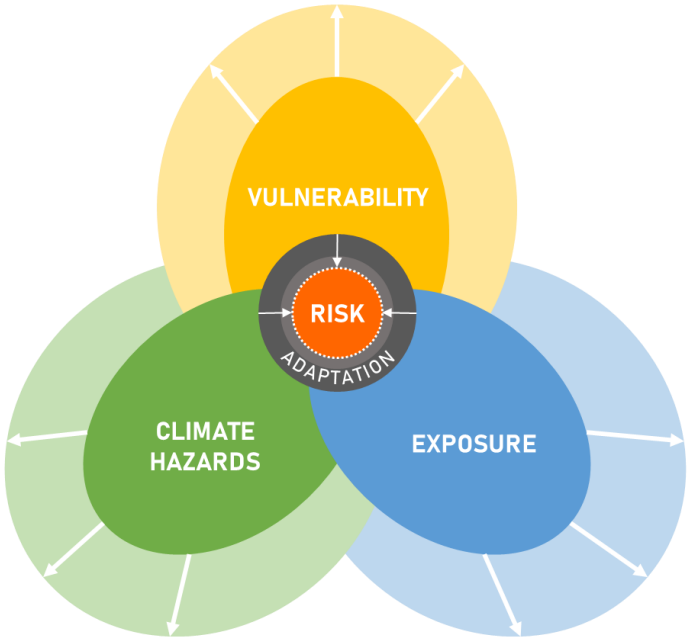

Figure 1 – The interplay between climate hazards, vulnerability and exposure that determines risk (based on IPCC, 2014 and IPCC, 2021)

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 aimed at local governments 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 Khâi-Ma 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 Khâi-Ma 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

The main climate projection for the Khâi-Ma LM points to hotter and drier conditions for the LM. Future projections show increases in temperature up to 3 °C. Rainfall predictions show future rainfall expected to range between -72.97 to 29.71.mm. The negative values indicate a deficit in rainfall compared to the baseline conditions and implies a possibility of receiving less rainfall. The upper end of the range suggests an increase in rainfall. The wide range between the negative and positive values reflects uncertainty in the prediction. Strategies should thus account for both potential drought conditions (lower end of the range) and heavy rainfall events (upper end of the range). Predicted settlement drought risk is high for the Aggeneys portion of the PSHSDA and moderate for Pofadder PHSHDA. The number of very hot days are expected to increase to between 30 to 65 days per year. Heatwave days are expected to increase by between 17 to 20 heatwave days across the LM. The Aggeneys/Pofadder PHSHDA's water supply

vulnerability is expected to increase for certain scenarios in the future due to reduced rainfall and runoff generation and increase in mean annual evaporation. The PHSHDAs' populous areas, rely solely on surface water. The climate change risks as indicated were validated by the stakeholders in the Khai Ma LM.

4.2. Priority climate-related hazards

For the Khâi-Ma LM the biggest risks are increases in temperature and drought conditions with the risk of heat extremes increasing significantly by 2050. Severe and persistent heat can place significant stress on the ecology and livestock and have implications for both human comfort and health. Heat-stress is also a significant pressure point for human health, ecology, livestock reproduction, and will have negative impact on labour productivity and could potentially be fatal should adequate measures not be taken for housing and building design. Reliance on only one source of water increases water supply vulnerability as water supplies decrease and demand increases. This therefore indicates the need to diversify potable water supply (i.e., water sources), improve groundwater recharge and conserve available water.

5. Adaptation Goals, Programmes and Actions

The section outlines the adaptation plan using goals and measures designed to help Khâi-Ma 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 Khâi-Ma LM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the nationwide engagements:

- Goal 1: To prioritise the health and safety of communities in the face of a changing climate.
- Goal 2: To ensure water security in the face of climate change.
- Goal 3: To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events.
- Goal 4: To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

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: To prioritise the health and safety of communities in the face of a changing climate.

Programme 1.1: Climate-Resilient Critical Infrastructure and Services for the Municipality.
This programme aims to enhance the resilience of critical infrastructure to climate-related hazards such as extreme rainfall and flooding. Actions include assessing the vulnerability of healthcare facilities, water supply systems, and emergency shelters, and implementing low-cost, resource-efficient measures to strengthen existing infrastructure. By leveraging partnerships with local businesses, NGOs, and community groups, the programme seeks to pool resources and expertise for effective infrastructure upgrades.

Actions:

i. Assess the vulnerability of critical infrastructure, such as healthcare facilities, water supply systems, and emergency shelters, to flood due to extreme rainfall events.
ii. Identify opportunities to enhance the resilience of existing infrastructure using low-cost, resource-efficient measures, such as retrofitting buildings with locally sourced materials, improving drainage systems using community labour, and repurposing underutilised spaces for emergency shelters.
iii. Seek partnerships with local businesses, NGOs, and community groups to leverage additional resources and expertise for infrastructure upgrades.

Programme 1.2: Community Health and Safety Promotion throughout the Khâi-Ma LM
This programme focuses on building local capacity and resilience to climate-related health risks. Through community workshops and training sessions, it educates residents on the health impacts of heatwaves, flooding, and vector-borne diseases. The establishment of community emergency response teams and the promotion of participatory approaches empower residents to take ownership of their health and safety. Informational materials on emergency preparedness and response strategies are distributed to ensure widespread awareness and readiness.

Actions:

i. Conduct community workshops and training sessions on climate-related health risks, including heatwaves, flooding, and vector-borne diseases.
ii. Establish community emergency response teams and train residents in first aid, disaster preparedness, evacuation procedures, and health promotion to build local capacity and resilience in the face of climate-related hazards.
iii. Empower community members to take ownership of their health and safety through participatory approaches, such as community mapping, hazard identification, and action planning.
iv. Distribute informational materials and resources, such as brochures, pamphlets, and posters, on emergency preparedness and response strategies.

Programme 1.3: Community Health Education and Outreach
This programme aims to disseminate key health messages and adaptation strategies to diverse communities through locally relevant and accessible educational materials. By using formats such as illustrated pamphlets, radio broadcasts, and community theatre, and translating materials into local languages, the programme ensures effective communication. Collaboration with community leaders, local

schools, religious institutions, and community groups helps convey health information and encourage behaviour change within their networks, promoting a healthier, more resilient community.

Actions:

i. Develop simple, locally relevant educational materials using accessible formats, such as illustrated pamphlets, radio broadcasts, and community theatre, to disseminate key health messages and adaptation strategies.
ii. Translate educational materials into local languages and culturally appropriate formats to reach diverse communities.
iii. Collaborate with community leaders, local schools, religious institutions, and community groups
iv. to convey health information and encourage behaviour change within their respective networks.

5.3. Adaptation programme: Goal 2

Goal 2: To ensure water security in the face of climate change.

Programme 2.1: Water Conservation and Management

This programme aims to enhance water efficiency and reduce wastage through cost-effective strategies. It involves developing a water conservation plan that includes simple, low-cost measures to minimise water wastage and increase efficiency.

Actions:

i. Develop a water conservation plan focusing on simple, low-cost measures to reduce water wastage and increase efficiency. By implementing low-cost water conservation measures, the municipality can reduce water bills and operational expenses associated with water supply and treatment.
ii. Prioritise regular maintenance of existing water infrastructure to minimise leaks and losses.
iii. Establish community-based monitoring systems to track water usage and identify areas for improvement.
iv. Implement community-led initiatives for rainwater harvesting and greywater recycling, utilising locally available materials.
v. Conduct regular leak detection surveys and repair activities to minimise water losses in distribution networks.

Programme 2.2: Capacity Building and Training

This programme focuses on educating and training the community and municipal staff to enhance water resource management. Community workshops on waterwise gardening and sustainable agricultural practices aim to reduce water demand and foster collective responsibility for water conservation.

Actions:

i. Organise community workshops on waterwise gardening techniques and sustainable agricultural practices to reduce water demand. Involving residents in water management initiatives fosters a sense of ownership and collective responsibility for water resources, leading to long-term sustainability.
ii. Train municipal staff on data collection methods and basic hydrological monitoring to improve water resource management.

iii. Collaborate with schools to integrate water conservation education into the curriculum and engage students in water-saving activities.
iv. Foster partnerships with local NGOs and academic institutions to access expertise and resources for water management.

5.4. Adaptation programme: Goal 3

Goal 3: To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events.

Programme 3.1: Risk Assessment and Planning

This programme aims to incorporate local knowledge and scientific data to identify and plan for climate risks. Community consultations and stakeholder engagement sessions will be conducted to gather local input for risk assessments.

Actions:

i. Conduct community consultations and stakeholder engagement sessions to gather local knowledge and input for the risk assessment process.
ii. Utilise climate modelling and scenario analysis to project future climate impacts and inform adaptation planning efforts.
iii. Facilitate participatory planning processes that empower communities to co-design and implement adaptation measures that address their specific needs and priorities. A co-benefit of this is that engaging local communities in adaptation planning and implementation will foster social cohesion and collective action, strengthening community resilience and solidarity.
iv. Organise community-led vulnerability assessments to identify priority areas and vulnerable populations in need of support.

Programme 3.2: Infrastructure Resilience and Enhancement

This programme focuses on upgrading critical infrastructure to withstand climate-related stresses and extreme weather events. It involves upgrading water supply systems, drainage networks, and transportation routes. Community-led vulnerability assessments will identify priority areas and vulnerable populations, ensuring targeted infrastructure improvements. This collaborative approach ensures that infrastructure upgrades are sustainable and meet the specific needs of the community.

Actions:

i. Upgrade critical infrastructure, such as water supply systems, drainage networks, and transportation routes, to withstand climate-related stresses and extreme weather events.
ii. Facilitate participatory planning processes that empower communities to co-design and implement adaptation measures that address their specific needs and priorities. Engaging local communities in adaptation planning and implementation fosters social cohesion and collective action, strengthening community resilience and solidarity.
iii. Organise community-led vulnerability assessments to identify priority areas and vulnerable populations in need of support.

5.5. Adaptation programme: Goal 4

Goal 4: To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

Programme 4.1: Rural Economic Diversification and Innovation

This programme focuses on fostering rural economic growth and innovation through the creation of supportive environments for green industries and local entrepreneurship. By establishing innovation hubs, leveraging community resources, and organising forums, the programme aims to stimulate business development in renewable energy, sustainable agriculture, and eco-tourism.

Actions:

i. Establish rural innovation hubs or incubators to support the development of local businesses and startups focused on renewable energy, sustainable agriculture, eco-tourism, and other green industries.
ii. Use existing community resources and volunteer networks to establish low-cost innovation hubs or entrepreneurship centres in community spaces.
iii. Organise community forums, pitch competitions, and local markets to showcase and support grassroots entrepreneurship and small-scale enterprises.
iv. Facilitate knowledge-sharing and skills development through peer-to-peer learning, mentorship programs, and online training platforms.
v. Facilitate access to markets, networks, and supply chains for rural producers and entrepreneurs through partnerships with wholesalers, retailers, and online platforms.

Programme 4.2: Capacity Building and Skills Development

This programme aims to enhance the skills and knowledge of rural residents through targeted training and educational initiatives. By collaborating with local institutions and leveraging digital technology, the programme seeks to offer cost-effective training on sustainable practices and create job opportunities for youth and unemployed individuals.

Actions:

i. Collaborate with local NGOs, community colleges, and vocational training centres to offer cost-effective training programs and workshops on sustainable farming practices, renewable energy technologies and green building techniques that are tailored to the needs of rural residents.
ii. Leverage digital technology and mobile learning platforms to provide accessible and affordable training opportunities to reach a broader audience.
iii. Partner with local industries and employers to create job placement programmes, apprenticeships, and internship opportunities for youth and unemployed individuals seeking entry into the workforce.

Programme 4.3: Infrastructure Development and Access to Services

This programme focuses on improving rural infrastructure and access to essential services through cost-effective methods and innovative financing. By implementing low-cost infrastructure improvements and exploring diverse funding mechanisms, the programme aims to enhance community services and support sustainable development in rural areas.

Actions:

i. Implement low-cost infrastructure improvements, such as road repairs, community water points, and renewable energy installations, using labour-intensive methods and locally available materials.
ii. Explore innovative financing mechanisms, including crowd-funding campaigns, community savings groups, and microfinance initiatives, to fund infrastructure projects and service upgrades.
iii. Seek partnerships with government agencies, development organisations, and private sector stakeholders to leverage resources and reduce financial burdens.

Programme 4.4: Natural Resource Management and Environmental Conservation

This programme aims to promote environmental stewardship and sustainable resource management through community engagement and conservation activities. By fostering partnerships and involving local volunteers, the programme seeks to enhance environmental education, support conservation efforts, and encourage sustainable agricultural practices.

Actions:

i. Foster partnerships with local schools, youth groups, and environmental organisations to promote environmental education, awareness, and stewardship within the community.
ii. Engage local volunteers and community groups in hands-on conservation activities, such as tree planting, habitat restoration, and waste management initiatives, leveraging community labour and resources.
iii. Provide technical assistance, training, and incentives for farmers to adopt sustainable agricultural practices, such as agroforestry, organic farming, soil conservation, and water-efficient irrigation methods.

6. Implementation Framework

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

6.1. Implementation framework: Goal 1

Goal 1: To prioritise the health and safety of communities in the face of a changing climate

Adaptation programme 1.1: Climate-Resilient Infrastructure and Services for the Municipality				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Assess vulnerable infrastructure. In this action the vulnerability of critical infrastructure, such as healthcare facilities, water supply systems, and emergency shelters, to flood will be assessed.	Increase in extreme rainfall events leading to flooding.	Municipal infrastructure department, technical services	Short term (< 5 years)	High
ii. Enhance the resilience of existing municipal infrastructure. In this action opportunities to enhance the resilience of existing infrastructure using low-cost, resource-efficient measures, such as retrofitting buildings with locally sourced materials, improving drainage systems using community labour, and repurposing underutilized spaces for emergency shelters will be identified.	Increase in extreme rainfall events. Temperature increases Increased heat stress	Municipal infrastructure department in collaboration with local businesses, NGOs and community groups	Medium term (5-10 years)	High
iii. Develop partnerships. In this action efforts will be made to seek partnerships with local businesses, NGOs, and community groups to leverage additional resources and expertise for infrastructure upgrades.	Increase in extreme rainfall. Temperature increases Increased heat stress	Municipal Manager and Municipal Infrastructure Department	Medium term (5-10 years)	Medium

Adaptation programme 1.2: Community Health and Safety Promotion throughout the Khai-Ma LM				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Organise community workshops and Training Sessions. In this action community workshops and training sessions on climate-related health risks, including heatwaves, flooding, and vector-borne diseases will be organised and conducted.	Increased heat stress Extreme rainfall leading to flooding. Increased water borne and communicable diseases (e.g. typhoid, fever, cholera and hepatitis	Namakwa District Environmental Health Department in collaboration with local health clinics and community organisations	Short term (< 5 years)	High
ii. Establish community emergency response teams. In this action community emergency response teams will be established, where residents will be trained in first aid, disaster preparedness, evacuation procedures. and health promotion to build local capacity and resilience in the face of climate-related hazards.	Increased heat stress Increase in extreme rainfall leading to flooding. Remoteness of rural communities and access to emergency response services.	Namakwa District Disaster Management Department in collaboration with local community leaders and organisations	Short term (< 5 years)	High
iii. Empower community members. In this action community members will be empowered to take ownership of their health and safety through participatory approaches, such as community mapping, hazard identification, and action planning.	Increase in extreme rainfall leading to flooding. Increased heat stress	Municipal Community Development Department	Medium term (5-10 years)	Medium
iv. Distribute educational materials. In this action informational materials and resources, such as brochures, pamphlets, and posters, on emergency preparedness and response strategies will be distributed to communities in the municipality	Increase in extreme rainfall leading to flooding. Increased heat stress	Namakwa District Environmental Health Department, in collaboration with local health educators and community groups	Short (<5 years)	High

6.2. Implementation framework: Goal 2

Goal 2: To ensure water security in the face of climate change.

Adaptation programme 2.1: Water Conservation and Management				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Develop a Water Conservation Plan. In this action a water conservation plan will be developed focused on simple, low-cost measures to reduce water wastage and increase efficiency.	Drought Water supply vulnerability Water security	Technical Services	Short term (< 5 years)	High
ii. Regularly Maintain Water Infrastructure such as pipes, treatment facilities, storage tanks etc. In this action regular maintenance of existing water infrastructure (pipes, treatment facilities, storage tanks etc.) to minimise leaks and losses will be prioritised, budgeted for and implemented.	Drought Water supply vulnerability Water security	Technical Services	Short term (< 5 years)	High
iii. Establish Community-Based Monitoring Systems. In this action community members will be trained and involved in monitoring the quality and quantity of water in the municipality.	Decreased quality of drinking water Increased concentrations of effluent and salt concentrations	Technical Services in collaboration with community	Short term (< 5 years)	Medium
iv. Implement community led initiatives. In this action community-led initiatives for rainwater harvesting and greywater recycling, utilising locally available materials will be implemented	Drought Water supply Water security	Technical Services in collaboration with community	Medium term (5-10 years)	High
v. Conduct regular leak detection surveys.	Less water available for irrigation and drinking	Technical Services	Short term (< 5 years)	High

In this action relevant municipal officials will conduct regular leak detection surveys and repair activities to minimise water losses in distribution networks.				

Adaptation programme 2.2: Capacity Building and Training				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Plan and organise community workshops. In this action community workshops on water-wise gardening techniques and sustainable agricultural practices to reduce water demand will be planned and organised.	Drought Water security Water supply	Community Development Department in collaboration with Environmental Department and local NGOs	Short term (< 5 years)	High
ii. Train municipal staff. In this action municipal staff will be trained on data collection methods and basic hydrological monitoring to improve water resource management	Drought Water supply Water security	Municipal Human Resources Department and Technical Services	Short term (< 5 years)	High
iii. Integrate water conservation education into school curriculum. In this action the municipality will collaborate with schools to integrate water conservation education into the curriculum and engage students in water-saving activities.	Drought Water supply Water security	Environmental Department and local schools	Medium term (5-10 years)	High
iv. Foster partnerships with NGOs and academic institutions. In this action partnerships with local NGOs and academic institutions to access expertise and resources for water management will be fostered.	Drought Water supply Water security	Municipal Community Development Department and Municipal leadership	Short term (< 5 years)	Medium

6.3. Implementation framework: Goal 3

Goal 3: To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events.

Adaptation programme 3.1: Risk Assessment and Planning				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Conduct community consultations and stakeholder engagement. In this action community consultations and stakeholder engagement sessions will be conducted to gather local knowledge and input for the risk assessment process.	Drought Health impacts from increased storm events	Municipal Community Development in collaboration with Environmental Department	Short term (< 5 years)	High
ii. Use climate modelling and scenario analysis. In this action climate modelling and scenario analysis will be obtained and used to project future climate impacts and inform adaptation planning efforts.	Drought Increased temperature Increase in extreme rainfall events	Municipal Environmental Department in collaboration with climate research institutions	Medium term (5-10 years)	High
iii. Facilitate participatory planning processes. In this action participatory planning processes that empower communities to co-design and implement adaptation measures that address their specific needs and priorities will be facilitated.	Drought Increase in heatwaves. Increased heat stress	Municipal Community Development Department, environmental department, and community leaders	Medium (5-10 years)	High
iv. Organise community-led vulnerability assessments. In this action community-led vulnerability assessments will be organised to identify priority areas and vulnerable populations in need of support.	Increased heat stress Drought Increase in extreme rainfall events.	Municipal Community Development Department in collaboration with Environmental Department and Local NGOs	Short (< 5 years)	Medium

Adaptation programme 3.2: Infrastructure Resilience and Enhancement				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Upgrade critical infrastructure. In this action critical infrastructure, such as water supply systems, drainage networks, and transportation routes will be upgraded so that they are able to withstand climate-related stresses and extreme weather events.	Heat stress Flood Water supply vulnerability Drought	Technical Services and environmental department	Medium term (5-10 years)	High
ii. Facilitate participatory planning processes. In this action participatory planning processes that empower communities to co-design and implement adaptation measures that address their specific needs and priorities will be facilitated.	Heat stress Flood Increase in extreme rainfall events Drought	Technical Services, Community Development Department and Environmental Department	Medium term (5-10 years)	High
iii. Organise community led vulnerability assessments. In this action community-led vulnerability assessments to identify priority areas and vulnerable populations in need of support will be organised.	Socio-economic vulnerability Heat stress. Floods Increase in extreme rainfall events. Drought	Municipal Community Development Department, in collaboration with Environmental Department and Local NGOs	Medium term (5-10 years)	Medium

6.4. Implementation framework: Goal 4

Goal 4: To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

Adaptation programme 4.1: Rural Economic Diversification and Innovation				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Establish rural innovation hubs. In this action rural innovation hubs or incubators to support the development of local businesses and startups focused on renewable energy, sustainable agriculture, eco-tourism, and other green industries will be established	Economic vulnerability Change in fruit production.	Economic Development Department in collaboration with local community centres and NGOs	Short term (< 5 years)	Medium
ii. Use community resources for innovation centres. In this action existing community resources and volunteer networks will be used to establish low-cost innovation hubs or entrepreneurship centres in community spaces.	Economic vulnerability	Community Development Department in collaboration with local community centres and NGOs	Short term (< 5 years)	High
iii. Organise community forums and markets. In this action the municipality will organise community forums, pitch competitions, and local markets will be organised to showcase and support grassroots entrepreneurship and small-scale enterprises.	Economic vulnerability	Municipal economic development department in collaboration with local business associations and community leaders	Short term (< 5 years)	High
iv. Facilitate access to markets and networks. In this action the municipality will facilitate access to markets, networks, and supply chains for rural producers and	Economic vulnerability	Municipal economic development department in collaboration with Trade Associations and Online Platforms	Medium term (5-10 years)	High

entrepreneurs through partnerships with wholesalers, retailers, and online platforms.				

Adaptation programme 4.2: Capacity Building and Skills Development				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Offer training programs and workshops. In this action municipality will collaborate with local NGOs, community colleges, and vocational training centres to offer cost-effective training programs and workshops on sustainable farming practices, renewable energy technologies and green building techniques that are tailored to the needs of rural residents.	Economic vulnerability Change in fruit production. Increased risk to livestock Increase in temperature	Municipality in collaboration with NGOs and vocational training centres	Short term (< 5 years)	High
ii. Leverage digital technology for learning. In this action the municipality will facilitate knowledge-sharing and skills development through peer-to-peer learning, mentorship programs, and online training platforms.	Economic vulnerability Socio-economic vulnerability	Municipality in collaboration with IT department and online platforms	Short term (< 5 years)	High
iii. Create job placement programs In this action with municipality will partner with local industries and employers to create job placement programs, apprenticeships, and internship opportunities for youth and unemployed individuals seeking entry into the workforce.	Economic vulnerability Socio-economic vulnerability	Community development department in collaboration with local industries and employers	Medium term (5-10 years)	High

Adaptation programme 4.3: Infrastructure Development and access to services				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Implement low-cost infrastructure improvements. In this action the municipality will implement low-cost infrastructure improvements, such as road repairs, community water points, and renewable energy installations, using labour-intensive methods and locally available materials.	Economic vulnerability Increased isolation of rural communities	Municipal infrastructure department in collaboration with community development department and NGOs	Medium term (5-10 years)	High
ii. Explore innovative financing mechanisms. In this action the municipality will explore innovative financing mechanisms, including crowd-funding campaigns, community savings groups, and microfinance initiatives, to fund infrastructure projects and service upgrades.	Economic vulnerability	Municipal Finance Department in collaboration with local savings groups and financial institutions	Medium term (5-10 years)	High
iii. Seek partnerships for resource leveraging. In this action the municipality will seek partnerships with government agencies, development organizations, and private sector stakeholders to leverage resources and reduce financial burdens.	Economic vulnerability	Corporative service in collaboration with Government agencies and private sector stakeholders	Medium term (5-10 years)	High

Adaptation programme 4.4: Natural Resource Management and Environmental Conservation				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Promote environmental education and stewardship.	Economic vulnerability	Municipal environmental department, in collaboration with	Medium term (5-10 years)	High

In this action the municipality will foster partnerships with local schools, youth groups, and environmental organizations to promote environmental education, awareness, and stewardship within the community.		schools, youth groups and NGOs		
ii. Engage community in conservation activities. In this action the municipality will engage local volunteers and community groups in hands-on conservation activities, such as tree planting, habitat restoration, and waste management initiatives, leveraging community labour and resources.	Economic vulnerability	Environmental Department in collaboration with community groups and NGOs	Medium term (5-10 years)	High
iii. Provide technical assistance for sustainable farming. In this action the municipality will provide technical assistance, training, and incentives for farmers to adopt sustainable agricultural practices, such as agroforestry, organic farming, soil conservation, and water-efficient irrigation methods will be provided.	Economic vulnerability Change in fruit production	Environmental department in collaboration with agricultural extension services and NGOs	Medium term (5-10 years)	High

7. Implications for the PHSHDA

In the development of the adaptation plan for Khai-Ma LM the focus was on initiatives that require minimal financial investment and rely on community participation and collaboration. By prioritising community engagement, capacity building, and knowledge sharing, the adaptation programme can effectively promote the health and safety of communities in the face of climate change. When taking into consideration the vision for the Pofadder-Aggeneys PHSHDA which is: "*The Pofadder-Aggeneys PHSHDA shall strive towards creating sustainable well-paying jobs that would be the cornerstone for a prosperous town full of development potential beyond mining*" it would be important to consider the following in the planning and development of the PHSHDAs. Rural economic diversification and innovation will be important as highlighted in goal 4 with a focus on revitalising rural economies by promoting entrepreneurship, innovation and sustainable industries. Public private partnerships and community-led initiatives should be encouraged to foster inclusive growth and job creation. Climate resilient, low carbon rural communities will require significant investment in renewable energy, sustainable agriculture, and green infrastructure. It is recommended that the development of renewable energy projects, such as solar and wind farms to reduce dependence on fossil fuels and mitigate greenhouse gas emissions is supported. Predicted climate change impacts indicate hotter and drier conditions for the municipality which will pose significant challenges to water availability and quality. As described in the actions for Goal 2 water security in the face of climate change is imperative. Water conservation measures, such as rainwater harvesting, efficient irrigation systems that will reduce demand and increase resilience to drought should be considered in the new housing developments. Climate change will also increase the frequency and severity of extreme weather events. In the planning and development of PHSHDAs it is recommended that comprehensive risk assessments be conducted to identify areas prone to climate hazards such as flooding and wildfires to reduce exposure and vulnerability of communities to these impacts.

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 or 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. 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.

9. Bibliography

Behsudi, A, 2021. What Is Mitigation vs Adaptation? IMF Finance Dev. Mag. 46–47.

Council for Scientific and Industrial Research (CSIR), 2019. Green Book | Adapting settlements for the future. GreenBook. URL https://greenbook.co.za/

Department of Environmental Affairs (DEA), 2018. Climate Change Bill.

Department of Environmental Affairs (DEA), 2019. National Climate Change Adaptation Strategy.

Department of Human Settlements (DHS), Republic of South Africa, 2020. Gazette Notice: Declaration of the Priority Human Settlements and Housing Development Areas (PHSHDAs) (No. Gazette Notice No. 526). Department of Human Settlements, Pretoria, South Africa.

IPCC, 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

IPCC, 2021. Annex VII: Glossary [Matthews, J. B. R., J. S. Fuglestvedt, V. Masson-Delmotte, V. Möller, C., Méndez, R. van Diemen, A. Reisinger, S. Semenov (ed.)]. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E.

IPCC, 2022. Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press., Cambridge, UK and New York, NY, USA.

National Treasury, 2018. Supplementary Guidance Note for the Built Environment Performance Plan (BEPP) 2019/20– 2021/22: Integrating Climate Response Priorities into the BEPP.

Pieterse, A., 2020. Mainstreaming Climate Change Adaptation into Municipal Planning: Lessons from two South African Cases (PhD Thesis). University of Pretoria.

Pieterse, A., du Toit, J., van Niekerk, W., 2021. Climate change adaptation mainstreaming in the planning instruments of two South African local municipalities. Dev. South. Afr. 38, 493–508. https://doi.org/10.1080/0376835X.2020.1760790

Pieterse, A., Ludick, C., van Niekerk, W., Arnold, K., Chilwane, L., Mateyisi, M., Nangombe, S., Steenkamp, K., John, J., Kotzee, I., Lück-Vogel, M., 2023. GreenBook MetroView: Methodology for eThekwini. Pretoria.

Republic of South Africa (RSA), 2011. National Climate Change Response White Paper.

Republic of South Africa (RSA), 2013. Spatial Planning and Land Use Management Act, 16 of 2013.

Republic of South Africa (RSA), 2015. Disaster Management Amendment Act.

South African Bureau of Standards (SABS), 2023. Technical specification: Adaptation to climate change — Requirements and guidance on adaptation planning for local governments and communities. Pretoria: SABS.