TOOLS FOR STRENGTHENING THE RESILIENCE OF INFRASTRUCTURE SYSTEMS AND SERVICES IN THE SADC REGION:

Lessons learned from the water/agriculture sector in which measures based on the guiding principle of RID have been implemented at the national or subnational level of SADC

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Statement of Purpose

This document draws attention to the need to systematically integrate climate change and risk considerations into infrastructure planning and decision-making processes in the SADC region. To this end, it introduces a conceptually integrated approach of embedding the climate risk assessment tool "PIEVC" as catalyser for an enabling environment for risk-informed development. Drawing from the learning experiences of a piloting exercise in SADC's Member State Lesotho, it provides an understanding of the services, benefits and potentials of regionally upscaling the tested approach to strengthen the resilience of infrastructure investments and advance risk-informed development in the SADC region. It thereby directly addresses the Priorities of the SADC Regional Resilience Framework 2020-2030 and to safeguarding the Strategic Objectives of the SADC Regional Indicative Strategic Development Plan (RISDP) 2020–2030.

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Introduction: The need to transform development pathways to risk-informed development

Every year, billions of dollars are being invested into long-term infrastructure projects, however, their planning processes often fail to take account of future climate change and related impacts. This leads to high risks of damage and misguided investments that harbour potentially disastrous consequences for the economy and society at large. Against this background, climate risk and vulnerability assessments provide a valuable tool to identify risks at an early stage and thus creating scope for prioritizing actions to strengthen the resilience of critical infrastructure systems.

The Southern African Development Community (SADC) has made significant progress in advancing regional cooperation and integration since its establishment in 1980, contributing to economic development towards poverty reduction in the region. In this regard, strengthening transnational infrastructure networks and services has proven to play a crucial role in advancing regional integration in the SADC but also in ensuring access to or supply by system-relevant critical infrastructures. Critical infrastructure refers to different assets, facilities, services, and systems that are essential for the social and economic functions, as well as the basic operations of a country and its government. In this priority area, the SADC can showcase various achievements, related to regional power transmission, transboundary water supply and sanitation infrastructure, regional transport networks, cross-border transmission links or regional meteorological services – to name a few. The continued priority role assigned to critical infrastructure development in support of regional integration is also reflected in Pillar II of the SADC Regional Indicative Strategic Development Plan (RISDP) 2020–2030, which aims towards quality, interconnected, integrated, and seamless infrastructure networks that increase access to affordable infrastructure services. Ensuring smooth and disruption-free functioning of these systems is important for the wellbeing of all members of a society and its development.

At the same time the SADC region is exposed to a wide range of existing and emerging hazards, such as drought, floods, tropical cyclones, diseases, pest infestations or conflict. Especially in a context of increased vulnerabilities as well as political, institutional, and technical capacity challenges, these threats can trigger negative impacts to critical infrastructure and its services, undermining many years of development achievements and reducing the development opportunities of Member States and the region. In a world of increasing interconnectivity, critical infrastructures (e.g., water, electricity, hospitals, transport, telecommunication, etc.) are characterized by a high degree of interdependence, which means that the impairment or failure of a single critical infrastructure can affect systems within the sector or spread to other sectors, with potentially severe consequences.

In this context, climate change is a major driver of risk – already today and likely more so in the future. By amplifying levels of exposure, vulnerability and/or reduced coping capacity, climate change can significantly exacerbate the level of disaster risk. Through the high degree of interdependence of critical infrastructures, climate-induced events can trigger a series of risks cascading along service delivery systems. For example, the increased or intensified occurrence of droughts can cause severe water shortages, which can have a direct impact on agricultural production, provision of critical state services (e.g., health care and electricity) as well as water-dependent industries (e.g., textile sector). This could lead to food shortages, socio-economic consequences, and increased poverty as well as disruptions in the health system, which relies heavily on smooth supply of water and electricity. Given the transboundary nature of water, energy, and food as well as other supply chains, risks originating in one country can impact the entire region. Therefore – also in light of regional integration – risks cannot longer be managed in isolation but need to be treated as an inevitable component of complex and interconnected systems.

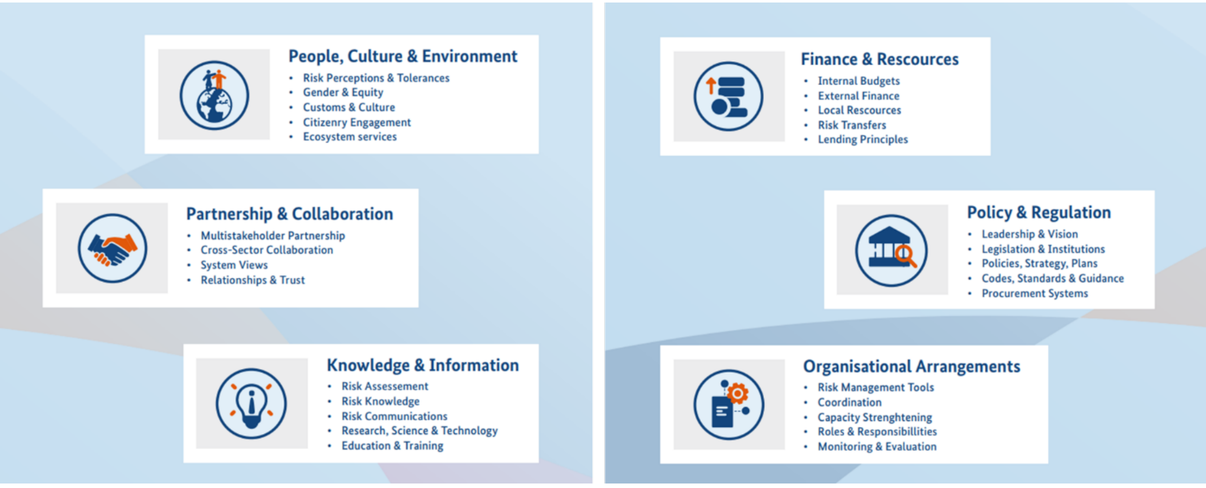
Increasing interdependencies and complex hazards and risks confront us with the challenge of finding new and more resilient approaches to reduce the risk of critical infrastructure failure. As highlighted in the SADC Regional Resilience Framework 2020-2030, there is currently a "*disproportionate emphasis on disaster risk management – i.e., preparation for emergency relief and response and recovery, rather than pro-active investment in resilience-building to equitably reduce disaster risk*". As reflected in the Seven Priorities of the SADC Resilience Framework 2020-2030, resilience building has to take place continuously at various levels of a system, across countries and sectors by different stakeholders, implicating the importance of a risk-informed development (RID) approach.

RID is an understanding of development that considers multi-faceted, dynamic, interdependent, transnational, simultaneous and systemic risks. The RID approach for decision-making, enables societies to prepare, mitigate, and adapt to the evolving and complex risk landscape with the goal of strengthening resilience and safeguarding development sustainably. Each development decision has the potential to foster resilient and sustainable development but is potentially also contributing to the creation of new or additional risks. RID thus describes a paradigm shift – across sectors and stakeholders – from managing single hazards towards incorporating existing and future risks in all development processes from the outset and choosing development pathways that prevent the creation of risks.

Towards an Enabling Environment for Risk-informed Development

Risk is deeply wired into our development practices and constructed by day-to-day decisions. Ensuring the systemic integration of climate change and risk considerations into development decision-making thus comes down to creating the favorable and enabling conditions. In this context, [UNDP (2021)](), conceptualizes an "**Enabling Environment"** as the conditions needed to ensure disaster risk reduction and climate change adaptation become an underlying principle of sustainable development. Based on the UNDP conceptual provisions, the Global Initiative on Disaster Risk Reduction (GIDRM), further developed the concept of an "**Enabling Environment"** towards an adapted "Framework for an **Enabling Environment for Risk Informed Development**" **(EE4RID)**, describing a set of policy, regulatory, organizational, procedural, and cultural conditions that can institutionalize risk within development decision-making (see Figure 1).

Figure 1: Six Dimensions and the Specific Components of the EE4RID Framework



The PIEVC Tool as an Enabler for Risk-informed Decision-making

Creating knowledge and understanding of the evolving and complex risk landscape confronted with is a key enabler for risk-informed decision-making. In this regard, the Public Infrastructure Engineering Vulnerability Committee (PIEVC) climate risk assessment tool provides a tried and tested approach to assess infrastructure component responses to the impacts of climate hazards under a changing climate, and related risks. Developed in Canada in 2006, the tool has since been used for well over 300 assessments worldwide, across nearly every type of public infrastructure (incl. grey and green). The tool is designed to be flexible and can be easily tailored to the application and context, considering both qualitative (expert judgement or local experience) and quantitative-probabilistic (e.g., threshold-based temperature indices) information and methods of assessment.

In addition to enhancing **risk information and knowledge**, the PIEVC also contributes to strengthening the enabling conditions of the other five dimensions of the EE4RID framework:
The results of the risk assessment directly inform recommendations on governance, management and **policy and regulation** actions to address identified climate vulnerabilities in the infrastructure system. Also, **organizational arrangements** – such as capacities and competencies to conduct risk management processes, the ability to respond to adapt to changing conditions as well as allocation of roles, responsibilities, and accountabilities of different stakeholders – are all considered in the risk analysis and are also subject of recommendations.
Further, the assessment can inform where **finance and resources** need to be planned for to address identified vulnerabilities of elements in the system of interest. This also includes

establishing an understanding where complementary external financing mechanisms may become necessary in the future under changing climatic conditions or where there is need for the establishment of financial protection mechanisms to cover residual risk.

Through application of a participatory, multi-stakeholder approach to risk assessment, the PIEVC methodology both relies on but also fosters **partnerships and collaboration** to inform risk analysis and understand the connectivity of different infrastructure elements within a system. Lastly, this also requires a focus on **people, culture, and environment**, through consideration of different perspectives and tolerances of acceptable risk as experienced by different stakeholders, particularly local actors, and people most at risk, including attitudes towards their natural environment. In this regard, the PIEVC approach is designed to include both grey and green infrastructure components, including consideration of socio-ecological relationships in both risk creation and resilience building.

Furthermore, the PIEVC approach can provide a promising approach to directly contribute to Priority 1 (Integrated governance and informed decision-making), Priority 4 (Robust and connected infrastructure), and Priority 7 (Understanding disaster risks including climate change) of the **SADC Resilience Framework 2020-2030**. Depending on its sectoral application, it can also enhance resilience with regards to social and human protection and mobility (Priority 2), food and nutrition security (Priority 3), sustainable urban centers (Priority 5), and natural resources management (Priority 6).

This in mind, the DRR Unit of the SADC Secretariat supported the piloting of the PIEVC tool (in conjunction with an EE4RID approach) in the water/agriculture sector and their interrelated infrastructure systems in SADC's Member State Lesotho.

Application of the PIEVC Tool in Lesotho: Protecting Public Investments for Resilient and Sustainable Water Supply

Background and Context

The Mountain Kingdom of Lesotho is the water tower for the Southern African region and accounts for 40% total volume of the Orange-Senqu River basin. Not only must Lesotho protect its water resources and critical water sector infrastructures for its own domestic water, food, and energy security, but also to meet its transboundary agreements with riparian states. The purpose of the Metolong Water Supply Infrastructure System in Lesotho is to increase access to water and improve the reliability of water supply to urban and peri-urban areas in Maseru and the neighboring towns and support continued economic growth. The construction of the 83-meter-high dam started in 2013 and the facility came online in 2016. It provides water to two-thirds of Lesotho's population and its serviceability is a key element of broader economic development, especially for the water-intensive textile industries.

There are indications that upstream land use practices and other threats are leading to erosion upstream of the dam, resulting in increased sediment loads reducing the lifecycle of the investment. Climate change represents an additional factor that can shift and increase existing threats to the structural integrity and the service reliability of the water supply system and its functional green and grey sub-systems, including the catchment, the reservoir, water treatment, dam, and water distribution network. Some climate change impacts have already been experienced and changes in climate and related hazard conditions are projected to increase in the future, including generally warming temperatures, increasing heat extremes, decreasing cold days, changes in hydrology, increasing frequency and intensity of convective and windstorms, increasing drought conditions, increases in the intensity of heavy precipitation, and increases in the frequency and extent of wildfires. Review of the feasibility and design documents and interviews with stakeholders knowledgeable of the dam suggested that little had been done in the past to consider the potential impacts of climate change on the water supply system and how climate change may influence the ability to deliver its intended services over time.

Against this backdrop, the Government of Lesotho, in cooperation with GIZ-GIDRM has engaged, under the umbrella of the National Integrated Catchment Management Program (ReNOKA), in the process to assess the prevailing and future climate risks of the Metolong Dam infrastructure system, and its relevant up and downstream components, including its reservoir and catchment, as well as water treatment plant and its water distribution system. This was achieved through the application of the PIEVC Tool in partnership with the Canada-based Climate Risk Institute (CRI). Applying the PIEVC methodology in Lesotho aims to provide a better understanding of the service reliability of the Metolong Water Supply Infrastructure System under changing climate conditions and identify potential consequences of varying water service levels for key user groups. The assessment formed the basis to evaluate implications for sustainable water provision (thereby, a contribution to sustainable development) in the catchment and the water sector from a risk-informed development perspective. It thus provides a critical tool to support decision-making and risk-informed planning and implementation processes in Lesotho.

Applied PIEVC Methodology and Approach

The risk assessment process was supported by a series of complementary methodologies and tools, including the PIEVC Tool for Infrastructure Vulnerability and Risk Assessment, the PIEVC High-Level Screening Guide (HLSG), and the PIEVC Green Tool. In general, the utilized PIEVC methodology consists of five steps:

- **Step 1:** Scope, Context, and Criteria.
- **Step 2:** Data Gathering and Sufficiency, encompassing climate and infrastructure data.
- **Step 3:** Risk Assessment, involving a) the development of an impact chain to conceptualize climate related and other drivers of vulnerability and their impacts, b) scoring of climate hazard likelihood and severity of impact, and c) evaluation of key impacts and risk prioritization.
- **Step 4:** Engineering Analysis, an optional process not covered in this assessment; and,
- **Step 5:** Reporting, which presents key findings and recommendations.

A summary of the assessment methodology and completed activities is shown in **Figure 2**.

Figure 2: Steps of the PIEVC methodology

Step 1: Scope, Context and Criteria	• Establish assessment objectives • Define the scope, including system(s) under assessment • Develop work plan • Identify and engage with stakeholders, validate scope in workshop
Step 2: Data Gathering and Sufficiency	• Define the infrastructure elements of the system • Define the climate hazard indices, scenarios, time horizons, and thresholds • Review supporting data and reports • Interview and validate with stakeholders familiar with system and data available
Step 3: Risk Assessment	• Prepare impact chains • Conduct exposure analysis for each infrastructure element – climate hazard in workshop • Conduct consequence scoring for each infrastructure element – climate hazard in workshop • Consolidate and validate risk scoring results with documented score rationale
Optional Step 4: Engineering Analysis	• Not completed as part of this assessment
Step 5: Reporting	• Describe the risk analysis and risk prioritization • Document limitations • Prepare recommendations • Prepare statement of vulnerability

The assessment process was driven by active multi-stakeholder engagement, involving over 50 participants, including e.g., infrastructure owners, government departments, community, and industry representatives.
Stakeholders actively contributed to the assessment through provision of data and information and data, offered insights about climate impacts and conducted risk scoring. Stakeholder involvement also proved to be essential for formulating recommendations to prioritize and manage risks. The engagement process included several interactive activities, including virtual and in-person workshops, training sessions, one-on-one interviews, site visits and validation sessions. This collaborative approach fostered a comprehensive and well-informed assessment, benefiting from the expertise and perspectives of a broad range of stakeholders.

To offer effective guidance for risk management policy and decision-making, the assessment integrated three geographical scales encompassing both grey and green infrastructure components:

1. the watershed and reservoir scale,
2. the dam scale, and
3. the water user's scale.

Each of these assessment scales was defined to explore aspects of the infrastructure and its function and relationships to potential impacts from various climate hazards. The impacts analyzed through this climate risk assessment target the physical infrastructure, as well as direct and cascading impacts from full or partial loss of service related to impacts caused by climate events, and potentially exacerbated by climate change.
All scales are highly interconnected: The dam is downstream of the watershed and reservoir, so impacts to water levels in the reservoir can have cascading impacts on the dam water supply and treatment. Impacts to the dam can reduce water supply, ultimately leading to impacts at the downstream user scale. This interdependency was considered as a critical part of the assessment even though each scale was initially assessed alone. This approach ensures a holistic view of the situation, benefiting the catchment area, region, and Lesotho as a whole.

Factoring climate projections into the PIEVC assessment

The climate assessment addressed three different time periods, each requiring its own set of climate analyses: present day (baseline), the 2050s (2041–2070), and the 2080s (2071–2100). Statistical climate projections for each of these time periods represent mean values across thirty years of data. Analyses of the 1981-2010 baseline period provided a basis for bias adjustment of the modelled, future climate and for general reference and analysis. The climate analyses suggest that the area around the Metolong Dam will undergo significant changes by the 2050s and 2080s, particularly if global greenhouse gas emissions continue to rise for the foreseeable future.

The following climate trends are expected[1]:

- **Warmer conditions**: Warming is projected across all seasons, with summers warming the most.
- **More heatwaves:** Periods of extreme heat are projected to become more frequent and significantly increase in duration[1].
- **Dryer conditions**: Total precipitation is projected to decrease in the winter and spring.
- **Shift in seasons:** The timing of seasons is projected to shift, with summer conditions extending approximately two weeks longer by the end of the 21st century[1].
- **Fewer cold days:** The number of days with lows below 10°C are projected to reduce by 34% by the 2050s, and 82% by the 2080s[1].
- **More extreme precipitation:** Precipitation extremes are projected to intensify and high intensity events to occur more frequently.
- **More severe drought periods:** The combination of warmer, hotter, and drier conditions is projected to lead to more severe droughts and increase the likelihood of wildfires.
- **More stormy weather:** Future climate change will favour the occurrence of intense storms, lightning, thunderstorms, and extreme winds and gusts.

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To effectively understand and address key impacts of the aforementioned climate conditions, impact chains were used to elucidate cause-effect pathways. This analysis revealed impacts related to livelihoods, food security, local economic systems, human health, environmental quality, water security, infrastructure damage, and water supply. This was then followed by qualitative assessment and application of professional judgment and experience to determine the exposure and likely effect of climate hazards on specific components of the infrastructure. To achieve this objective, the PIEVC methodology considers a series of assessment matrices to assign an estimated likelihood of occurrence and an estimated severity of impact score to each potential interaction. For each infrastructure–climate hazard interaction, the respective exposure, severity of impact (vulnerability), and climate likelihood of occurrence (hazard) was multiplied in order to receive a risk score. The combined scores were then used to quantify the PIEVC Priority of Climate Effect (i.e., risk) of each infrastructure-climate interaction, allowing prioritization and/or ranking of risk categories as shown in Table 1 below.

Table 1: Risk Scores and Categories

Category	Values	Description
Negligible Risk	R = 1 or 2	These risk events typically do not require further consideration or can be managed with ongoing Operations and Maintenance procedures and activities.
Low Risk	R = 3 or 4	Risk mitigation controls are typically not required or can be managed with ongoing Operations and Maintenance procedures and activities.
Special Case	**R = 5**	Special cases are extreme climatic events having a low probability of occurring, but which would result in very serious damage if it occurred. For example, a tornado or extreme rainfall that corresponds to a 1 in 100 years event. As well as climatic event which occurs frequently but has a negligible impact after an individual occurrence, however its repetitive frequency can cause premature wear of the physical components. For example, an increase in freeze-thaw cycles.

[1] Values shown were computed using SSP5-8.5 scenario and the median value of 35 climate models.

Moderate Risk	R = 6, 8 or 9	Some medium-term risk mitigation controls are required to reduce risks to lower levels
Significant Risk	R = 10, 12, 15 or 16	High priority risk mitigation control measures are required (to be considered, planned, and addressed in the near future)
Major Risk	R = 20 or 25	Immediate risk mitigation controls and action required

Results of applying the PIEVC methodology

The infrastructure components for the Metolong Dam and its supporting systems were found to be generally resilient, but with a significant sub-set of risks which indicate potential vulnerability. The watershed and reservoir scale had the highest number of significant (25%) and major risks (9%) in the 2050s. By the 2080s, 10% of risks across all three scales were classified as major. Some of these risks can be managed through usual operating practices, however additional remedial measures are required to reduce significant and major risks in future time horizons.

Selected findings of the risk assessment include:

- Occurrence of heavy precipitation scenarios pose “significant” to “major” risk to watershed components included risks to rangeland, agricultural lands, wetlands, forest, and transportation networks.
- Increase of heavy precipitation scenarios was identified as posing a “major risk” to erodible soils in the watershed and reservoir.
- Heat waves and different heavy precipitation scenarios put the functioning of the water treatment works at “significant” risk.
- Increased occurrence of 100-year flood events creates significant risk to various components of the dam infrastructure, specifically drainage and access galleries, outlet works, ICT, and supporting infrastructure.
- Pumping stations, transmission and distribution mains as well as water demand are expected to face “moderate” to “significant” risk during heatwaves and heavy precipitation scenarios.
- Heat waves and different heavy precipitation scenarios put people’s and worker’s health and safety at “high” risk across all scales.

Based on the risk assessment results at all three scales, recommendations were derived regarding governance, management and policy actions, additional studies, data collection and monitoring, and remedial measures.

The PIEVC Assessment from an EE4RID Perspective

As illustrated above, the PIEVC Assessment of the Metolong Dam System contributed to strengthening the enabling environment for risk-informed development in Lesotho on multiple dimensions. At the same time, for application of the PIEVC methodology to be able to achieve its full potential it is necessary to embed the assessment in a set of enabling organizational, procedural, policy, regulatory and cultural conditions (i.e., an enabling environment).

Guided by the EE4RID Framework, a baseline analysis of the enabling environment for RID in Lesotho was conducted by GIDRM. The analysis captured current state of play, priority actions and good practices as well as constraints and challenges regarding enabling conditions for RID in Lesotho, along all six dimensions and sub-components of the Framework. While this baseline analysis set its focus on the national level, it provided a valuable contribution understanding the broader setting the assessment is situated in. On this basis, concrete levers for strengthening the enabling conditions for RID through a successful implementation and use of the PIEVC assessment were identified and actualized as part of the assessment process. These are briefly outlined with regards to each dimension of the EE4RID framework below.

While the results of a PIEVC assessment provide valuable information on the vulnerability of the respective infrastructure system and related risks under current and future climate conditions, its participatory approach also relies on harnessing existing **risk information and knowledge** from the expertise and perspective of stakeholders. This was enabled through an Inception Workshop held in August 2022 to jointly define the scope of the assessment among stakeholders and share experiences with climate impacts and management issues in the region and catchment. Further, one-on-one interviews were conducted with experts to better understand the system under assessment and identify additional data. Bringing together stakeholders with diverse knowledge, expertise, and lived experience during a four-day Risk Assessment Workshop in February 2023 played an indispensable role in informing the validation of climate impact chain models, the scoring of severity of climate impacts on elements, and developing fit-to-context recommendations.

To this end, creating **partnerships and collaboration** among key stakeholders was imperative for the success of the PIEVC Assessment of the Metolong Dam System. By bringing together over 50 practitioners, managers, and decision-makers from different sectors (e.g., public infrastructure & service provision; natural resources, water & land management; climate & meteorology; disaster risk management; forestry; agriculture; industry; academia; and local communities), the process contributed to creating a systems perspective, building constructive relationships as well as creating co-ownership and collective accountability among stakeholders.

Capacity development measures were implemented as a key **organizational arrangement** to ensure that participants were well-equipped to apply the PIEVC methodology in the context of Metolong Dam System as well as to support similar climate risk assessments in the future. An online webinar series trained and certified diverse stakeholders on the fundamentals of climate risk assessments, the PIEVC approach and the value of multidisciplinary expertise and insight. Following a learning-by-doing approach, acquired knowledge and skills were strengthened through joint implementation of the risk assessment under application of the PIEVC methodology. Lastly, a two-day virtual Applied Climate Science training was held to provide additional details on climate science, the assessment completed for Metolong, and how results could be leveraged in the future.

Further – also addressing the dimension of **organizational arrangements** – working groups representing the three assessment scales (watershed and reservoir, dam, and users) were formed to foster cross-sector multi-stakeholder coordination. Participants involved expressed interest to continue meeting in these groups a few times per year to discuss climate risk issues and measure progress on implementing adaptation as per recommendations of the assessment. This provides a format to routinely reassess climate-related risk to the infrastructure systems and dependent sectors.

By way of the PIEVC approach, high importance is assigned to consideration of **people, culture, and environment** in the assessment process. To this end, it was key to ensure inclusion and close engagement of all relevant stakeholders, especially local actors, throughout the process – from inception over implementation to final validation. This proved essential to ensure an accurate understanding of the context, create local ownership and thus increase the effectiveness, usefulness, and sustainability of this climate risk assessment.

Climate risk assessments, like the PIEVC tool, are always a means to an end – strengthening resilience towards climate risks and safeguarding development. They only fulfil their purpose if their findings are also considered and integrated into planning and decision-making processes. In this regard, political commitment is a key enabler for tabling risk considerations in **policymaking and regulation** and **financial planning processes**. Following the risk assessment, participants presented findings and recommendations to relevant decision-makers from different institutions, sparking discussions on related adaptation options and risk-informed development pathways.

In addition, a risk analysis of Lesotho's current National Strategic Development Plan (NSDP) as well as mapping of entry points for integrating a RID approach into future versions of the plan, contributed further to placing consideration of risk management on the political agenda in a wider and intersectoral sense. These efforts laid the foundation for initiating the institutionalization of risk assessments in planning and management of critical infrastructure systems in Lesotho at large.

PIEVC Tool and its Relevance for the SADC Region

The applied methodology and lessons learnt from piloting risk assessments in Lesotho provide high potential for direct upscaling to water resource management at the regional level through the integration into the Orange-Senqu River Commission (ORASECOM) and/or other River Basin Organizations (RBOs). RBOs can therefore play a pivotal role in enhancing climate resilience of water infrastructure and regional water security under their respective mandates, and in cooperation with their member states. This can also be done in preparing bankable climate resilient infrastructure projects for their respective jurisdictions.
In the same token, engaging in strategic debate on how climate risks can be more systematically reflected in regional and transboundary water resource and infrastructure investment planning, also during an advocacy and awareness workshop on climate sensitive infrastructure investment planning held in Maputo in September 2023 with RBO representatives from various SADC Member States aspires to highlight the need for developing policy guidance products for the institutionalization of climate resilient infrastructure investments in RBO's and SADC's governance frameworks.
Therefore, fostering this interface between the national and regional level is also relevant towards the use of the risk-informed development guiding principles, tools, and methods to strengthen the resilience of existing and future infrastructure investments for SADC's regional integration. In light of Pillar 2 (Infrastructure development in support of regional integration) of the SADC RISDP 2020-2030, the PIEVC and EE4RID approach can provide a valuable methodology and serve as a decision support tool to risk-inform infrastructure planning processes and contribute to safeguarding investments and development achievement across sectors.

Lessons learned and concluding reflections

The successful piloting of the PIEVC tool in a SADC Member State (i.e. Lesotho) demonstrated how climate-proofing of infrastructure services can be case-specific yet methodologically applicable and relevant to the whole SADC and its interconnected infrastructure in creating an environment supportive of risk-informed development. Both the PIEVC methodology as well as the EE4RID are designed to be flexible and easily tailored to the application and context. In addition to water supply and management systems, the PIEVC methodology can be adapted and applied to all types of infrastructure systems, including e.g., buildings, storm water/wastewater systems, roads, and associated structures (e.g., bridges and culverts), electricity distribution or airport and harbor infrastructure. In this sense it is safe to conclude that, the PIEVC methodology as well as the EE4RID may further contribute to the SADC's Secretariat and its Member States in institutionalizing risk at the heart of development decision-making processes, as reflected for example along in the Priorities of the SADC Regional Resilience Framework 2020-2030.