ADAPTATION FUND BOARD SECRETARIAT TECHNICAL REVIEW OF PROJECT/PROGRAMME PROPOSAL

PROJECT/PROGRAMME CATEGORY: Regional Project Concept

Countries/Region: Botswana, Malawi, Mozambique, South Africa, Zambia, Zimbabwe
Project Title: Enhancing Water and Food Security through Sustainable Groundwater Development in the SADC Region
Thematic Focal Area: Transboundary water management
Implementing Entity: International Fund for Agricultural Development (IFAD)
Executing Entities: SADC Groundwater Management Institute
AF Project ID: AF00000265
IE Project ID:
Requested Financing from Adaptation Fund (US Dollars): 13,932,000
Reviewer and contact person: Dirk Lamberts
Co-reviewer(s): Imèn Meliane
IE Contact Person: Paxina Chileshe

Technical Summary	The project "Enhancing Water and Food Security through Sustainable Groundwater Development in the SADC Region" aims to support sustainable and cooperative management of transboundary groundwater to strengthen the climate resilience of agriculture and agribusiness in Transboundary Aquifer (TBA) areas of Southern Africa through an evidence-based approach. This will be done through the three components below: Component 1: Data, information and knowledge for transboundary groundwater management policy and decision making (USD 900,000); Component 2: Joint Strategic Action Plans (JSAPs) for climate-responsive governance, management and use of TBA groundwater resources (USD 1,720,000); Component 3: Climate-resilient agricultural livelihoods and infrastructure in TBA areas (USD 10,280,000). Requested financing overview: Project/Programme Execution Cost: USD 613,000 Total Project/Programme Cost: unclear (please see CAR 9) Implementing Fee: USD 1,029,400 Financing Requested: USD 13,896,900

	The proposal includes a request for a project formulation grant of USD 50,000. The initial technical review raises several issues, such as the high risk of maladaptation associated with development of groundwater extraction, compliance with ESP and GP, limited consultations, and uncertain sustainability, as is discussed in the number of Clarification Requests (CRs) and Corrective Action Requests (CAR) raised in the review.
Date	25 January 2023

Review Criteria	**Questions**	**Comments**	**RESPONSE**
Country Eligibility	Are all of the participating countries party to the Kyoto Protocol, or the Paris Agreement?	**Yes.**	
	Are all of the participating countries developing countries particularly vulnerable to the adverse effects of climate change?	**Yes.** Changes to the amount, intensity and predictability of rainfall in much of southern Africa due to climate change causes a burden on smallholder farmers to secure their food and agricultural production.	
Project Eligibility	1. Have the designated government authorities for the Adaptation Fund from each of the participating countries endorsed the project/programme?	**Yes.** As per the endorsement letters dated 1 April 2022 (Botswana), 30 September 2022 (Malawi), 14 February 2022 (Mozambique), 6 October 2022 (South Africa), 27 September 2022 (Zambia) and 7 February 2022 (Zimbabwe).	
	2. Does the length of the proposal amount to no more than fifty	**Yes.**	

	(50) pages for the project/programme concept, including its annexes?	The document submitted amounts to 50 pages. Annex 3 is a page containing non-functional links to reports, and those have not been included in the review.	

	3. Does the regional project / programme support concrete adaptation actions to assist the participating countries in addressing the adverse effects of climate change and build in climate resilience, and do so providing added value through the regional approach, compared to implementing similar activities in each country individually?	**No.** 1. Conceptual approach. Paragraph 3 of the proposal states that "*Infrastructural developments intended to safeguard water supplies have increased the geographical unbalance of water resources, as many dams have been built to store water during unpredictable and often long dry periods, particularly in South Africa and Zimbabwe. Inadequate extent and maintenance of existing water infrastructure, unclear mandates for shared watercourse institutions and limited institutional capacity all hamper transboundary water management, particularly under climate change conditions*", highlighting the failures of infrastructure development for surface water resources, and failed transboundary water management in the region, and globally. Many of those 'failed' investments were established with international financing and technical support not dissimilar to that which is the subject of this funding request. The proposal does not provide assurances that the outcomes and outputs of this project will be different, that the transboundary management of the invisible groundwater resources will be more effective than that of the surface water resources, or that the challenges of groundwater use and allocation can be overcome. The suitability and preferability of groundwater resources as adaptation measure is not shown. The project-enabled and promoted development of groundwater use infrastructure is likely to bring about unsustainable extraction,	**CAR 1**: The reviewer correctly highlights the issue of maladaptation as there have been many global groundwater depletion cases (in China, India, Pakistan and the USA) driven mainly by irrigated agriculture. Groundwater use is accelerating to diversify the water supply mix and build water resilience, hence the caution. However, in sub-Saharan Africa, the current groundwater use remains under 5% of the national sustainable yield suggesting that groundwater has the potential to be a foundational resource to support irrigated agriculture, urban and rural water security, and drought resilience across the region, as it has in many other global regions. Analysis concurs that, although many countries in Africa appear water-stressed in global water scarcity indices when factoring in groundwater storage and the relatively small demand for drinking water, universal coverage for drinking water could be achieved with little impact on regional water stress. Our focus is to develop the resource sustainably from the outset, strategically, and at scale to counter chronic water stress or the recurrent and increasing drought threat in SADC hard-hit regions.

		which is even more probable than that associated with the 'failed' surface water investments. Effective transboundary management is the only mitigation against this maladaptation but as the proposal clearly illustrates the likelihood of establishing such effective management is very low. Paragraph 6 of the proposal includes a definition as follows: "*From henceforth, sustainable groundwater management in this proposal is defined as the development and use of groundwater resources to meet current and future beneficial uses, including to support climate change adaptation, without causing unacceptable environmental or socioeconomic consequences (e.g., maladaptation).*" This statement on consequences does not alter the inherent risks associated with the activities nor the environmental and social settings in which they will take place. It also does not increase the likelihood of achieving the intended effective transboundary groundwater resources management. For the Transboundary Diagnostic Analyses (TDAs) that are envisaged under Output 1.1 to be of sufficient quality the allocated budget of USD 900,000 will be inadequate considering the major knowledge gaps that would need to be addressed. In addition, confident modelling of the hydrological processes will require extensive time series of a wide range of relevant data of good quality from throughout the resource. The proposal does not mention the existence of such data. The proposed	Safeguarding and providing water storage capacity is crucial for climate adaptation as it provides a buffer against floods and droughts and balances increasing water variability. Groundwater has displayed drought resilience in the past, and the presence of aquifers (with their large volumes of stored water) provides a natural solution for deployment in climate-change adaptation. Therefore, water management widely requires strategic rethinking to ensure resource reliability for climate-change adaptation, with increased investment in conjunctive use, managed aquifer recharge, demand-side/supply-side management, and quality protection. Our focus is not on developing groundwater extraction infrastructure per se but on climate-resilient interventions, which will include: (1) the broader adoption of blended grey–green–blue infrastructure, (2) implementing pumping regimes that preserve and protect aquifers, (3) joint management of surface water and groundwater, (4) mapping, conserving, maintaining or rehabilitating (groundwater-dependent) wetland ecosystems and (5) ensuring extensive cooperation among neighbouring States to

		continuous monitoring of boreholes is limited to measuring conductivity, which will be used as a proxy for overall water quality. As such, this potential is very limited, and there is no information provided to substantiate that the use of this indicator is adequate or relevant to monitor the quality of the groundwater resource. The governance arrangements described in paragraphs 49 and 50 are unclear. They are based on a single pilot of a comparable development of which it is unclear if it was successful or even functional. Paragraph 50 states that the roles and responsibilities of the actual TBA governance structures – the Multi-Country Cooperation Mechanisms (MCCMs) – will be further elaborated, while their role would be so critical. In addition to being unclear, paragraph 51 states that the Council of Ministers of the relevant River Basin Organisation (RBO) is the decision-making body for the endorsement of the JSAPs and any funds channelled through the RBO for the implementation of the JSAP, including for setting its implementation priorities. In practice this means that ministers of countries not involved in a TBA may get to decide on its management. It is very hard to see how any single country would agree to ceding such a level of authority. Paragraph 57 states the project 'approach to avoiding maladaptation'. It does not address any of the issues described above.	manage rivers and aquifers affected by climate change. To support our efforts to avoid maladaptation, we have strengthened Component 1 by including an output to construct regional numerical groundwater models for the TBAs. Hence, our efforts to avoid maladaptation at a larger scale in the TBAs include diagnostic analysis and numerical modelling in **Component 1** to identify significant risks and responsible adaptation strategies throughout the implementation of **Components 2 and 3**. Developing a groundwater model of the aquifer systems enables the quantification of groundwater and evaluation of groundwater dynamics. This includes quantifying and evaluating groundwater inflow (recharge from rainfall and lateral inflow), groundwater flow through the aquifer and groundwater outflow (subsurface drainage, seepage, evapotranspiration and abstractions). The construction of the groundwater models allows interrogation of various pumping scenarios, e.g., for simulating climate variability and change, increasing abstraction related to irrigated agriculture, up-coning of salt water and so forth. We

		The conceptual approach of the project has an unacceptable likelihood of leading or contributing to maladaptation. 2. Concrete adaptation. Paragraph 17 describes that there is still considerable uncertainty regarding the possible climate futures for the transboundary (surface) river basins in the region. Paragraphs 19-24 and 26-29 present forecasts on precipitation and temperature, but not on aquifer recharging. Only in paragraph 25 is there some speculation on the impact on groundwater tables, but only due to increased borehole extraction. "*Groundwater recharge will be reduced under all scenarios, and general water supply*." No further qualitative and no quantitative forecast arguments are provided. The link between the described climate change events and the implications for the aquifers is entirely lacking. Apart from some speculation on increased demand for irrigation water there is no description or consideration of the mechanics of climate change impact on these aquifers, direct or indirect. No other climate change adaptation measures are taken into consideration. 3. Added value through the regional approach. Per se, there is little added value from the selected regional approach as benefits of regional cooperation are mostly limited to those countries sharing a common aquifer. The existence and involvement of the SADC Groundwater Management Institute provides a justified regional approach. However, most of	understand that we operate in an in-situ data-scarce environment, so we need to recombine different datasets, e.g., reanalysis products, satellite data, and citizen science data. We have worked with machine learning algorithms to downscale datasets in data-scarce TBAs. Our primary monitoring system intends to deploy automated loggers with water level and quality monitoring functions. The automated loggers measure TDS/Electrical Conductivity to serve as an indicator for parts of the aquifers with deteriorating water quality, where follow-up of the full complete set of water quality parameters can be implemented. In groundwater applications, conductivity can be used to identify saline intrusion, while it can also be used to determine pollution events. The secondary monitoring systems will be risk-specific, focussing on the chronic lowering of groundwater levels, reduction of groundwater storage, depletion of interconnected surface water, saline water intrusion, degradation of water quality and land subsidence. We recognise the importance of institutional arrangement. The SADC-

		the critical collaboration issues between countries sharing an aquifer will relate to political matters and commitments, at which level the potential contribution of a technical institute is very limited, the more as it invariably will involve other countries without a stake or direct interest. **CAR 1:** Please revise the concept proposal to eliminate or greatly reduce the risk of maladaptation associated with the institutional developments and the construction of groundwater extraction infrastructure.	GMI is an interlocutor with national governments and regional and international groundwater initiatives and institutions. SADC-GMI's value proposition as the implementer of this regional initiative is invaluable as the only groundwater regional institution that enjoys credible recognition from all the 16 SADC Member countries that variously share TBAs amongst themselves. SADC has established National Focal Groups in the respective countries and implemented the Multi-country Cooperation Mechanism developed in the Stampriet Transboundary Aquifer System by UNESCO in the Limpopo River Basin Commission. The same mechanism/approach is being developed for the Buzi, Pungwe and Save River Basins by SADC-GMI. This leads to collaboration and cooperation between the different countries. Climate adaptation requires extensive cooperation among neighbouring States to manage rivers and aquifers affected by climate change. The cooperation mechanisms apply to the countries sharing the aquifers. No cooperation mechanisms cede national sovereignty. Strengthening the knowledge component (Component 1) with the

			requisite budget increase and focusing on climate-resilient interventions in Component 2 will mitigate maladaptation. We added to the CN our understanding of the implications of climate change on groundwater resources. Understanding how climate change affects groundwater resources in the TBAs, identifying potential risk areas, determining the implications for these vulnerable areas, and developing mitigation and adaptation strategies are complex. Attributing observed changes in groundwater level, storage, discharge, and quality to climatic changes has proven difficult in most parts of the world because of inadequate monitoring systems for modelling and validation. However, the projected impacts include the following: groundwater recharge changes, groundwater quantity changes (storage changes), changes in discharge and groundwater-surface water interaction patterns, groundwater quality degradation, and groundwater-dependent ecosystems (GDEs) changes. The recharge of aquifers in semi-arid areas such as SADC is episodic and

			increasingly dominated by focused recharge, such as flood events. The observations of hyetograph-hydrograph responses from the semi-arid regions show that water levels respond after overcoming a certain precipitation threshold. Overcoming this threshold can be (i) a series of individual precipitation events which forms part of a prevailing regional weather system and (ii) a single, heavy precipitation event over a short period like the rain-week patterns. This means future changes in variability are more critical than mean precipitation. The assumption that climate change reduces groundwater resources significantly in arid environments requires more observation-driven research. Due to extreme annual precipitation, groundwater recharge to many large-scale aquifer systems may increase under climate change. However, the magnitude of this increase is unlikely to offset the impact of human withdrawals in areas of intensive abstraction. Understanding groundwater storage changes due to drought conditions are also significant and needs more research. Gravity Recovery and Climate Experiment (GRACE)-analysis of large groundwater systems in Africa does

			not show a natural reduction in groundwater storage, but the small-scale analysis may mask local-scale effects. Understanding the potential anthropogenic impacts becomes critical, and integrated hydrological models are required. Groundwater discharge can include direct evaporation and transpiration and groundwater flow to the surface, including discharge to wetlands and rivers. In many hydrogeologic settings, groundwater discharges help to sustain surface waters during periods of low or no rainfall by sustaining baseflow. The modified recharge, discharge and groundwater levels affect GDEs as the anticipated changes will be beyond ranges of normal fluctuation. The climate is expected to affect input (recharge) and output (discharge) and influence groundwater quality. The temperature sensitivity of chemical and biological processes seems to indicate that small temperature changes driven by current warming should have a detectable effect on the ecology of aquifers and the composition of groundwater itself. We believe that climate adaptation requires extensive cooperation among neighbouring States to manage rivers

			and aquifers affected by climate change. Joint data and knowledge-sharing arrangements and joint monitoring of basin conditions are prerequisites for successful transboundary cooperation in an era of climate change.

	4. Does the project / programme provide economic, social and environmental benefits, particularly to vulnerable communities, including gender considerations, while avoiding or mitigating negative impacts, in compliance with the Environmental and Social Policy of the Fund?	**Unclear**. All the envisaged economic, social and environmental benefits of the project are conditional on avoiding the maladaptation described above. Please see **CAR 1** above. The project accumulates at each step implementation and safeguards, risks and uncertainties through its approach, envisaging the sequential development of first TDAs, then SAPs and finally implementing agreed activities. **CR 1:** Please clarify why the goals of the project are most likely to be achieved by a single project approach rather than a more programmatic approach allowing for confirmation and consolidation of outcomes of previous stages. The economic, social and environmental benefits of the project have been described in generic terms. The activities of component 3 are mostly unidentified at this stage. **CR 2:** Please clarify how the number of beneficiaries of the activities of component 3 has been determined. Groundwater extraction is notoriously hard to monitor at aquifer level. It is unclear if or how	**CR1:** The approach has been reviewed under CAR 1, and the project components are aligned to achieve specific outcomes and are well aligned with the project objectives. Moreover, the approach is now more on the programmatic approach than the single project approach The economic, social and environmental benefits of the project have been elaborated in section C of the concept note. **CR2**: The approach under component 3 has now changed to focus on households which makes the quantification of direct and indirect beneficiaries now be easier during the elaboration of the results framework for the project **CR3:** The spatial network design will be finalized during the TDA and numerical modelling. The positioning criteria would potentially include borehole density (based on international best-practice), pristine areas (no land-use activities), aquifer yield, recharge, base flow etc. We put forward an estimated number of boreholes for output 1.3. Existing boreholes will augment this number in

		the proposed number of monitoring sites has the capacity to provide the monitoring that will be required to enable sustainable management of groundwater extraction. **CR 3:** Please clarify how the proposed monitoring elements of the project will be adequate for effective management of increased groundwater extraction. There is no reference to a gender analysis that was carried during the formulation of the project to inform its design. Other than generic references to policies of the IE and EE there are no specific gender goals set. **CR 4:** Please clarify how gender considerations in the project design were informed by a relevant gender analysis. Kindly note the updated Gender Guidance Document for Implementing Entities on Compliance with the Adaptation Fund Gender Policy https://www.adaptation-fund.org/wp-content/uploads/2017/03/AF_GenderGuidanceDocument_Final_15Aug-2022_clean_16Aug-clean-3.pdf	the TBAs as significant groundwater infrastructure is already in place. **CR 4**: An initial Gender Analysis was conducted the summary is included in the concept note and details attached to the Concept Note as an Annex 4
	5. Is the project / programme cost-effective and does the regional approach support cost-effectiveness?	**Unclear.** The proposal contains no analysis that would allow an appreciation of its cost-effectiveness or that of the regional approach. The relevant section is limited to operational cost-saving arguments and justification of the need of a TBA-wide approach. The economies of scale that can be expected from the regional	**CAR 2:** An analysis of the project's cost-effectiveness is presented in Section D of Part II of the document.

		approach are uncertain since each TBA will require a high degree of tailored approach. **CAR 2:** Please provide a demonstration of the project cost-effectiveness from a sustainability point of view.	
	6. Is the project / programme consistent with national or sub-national sustainable development strategies, national or sub-national development plans, poverty reduction strategies, national communications and adaptation programs of action and other relevant instruments? If applicable, it is also possible to refer to regional plans and strategies where they exist.	**Yes.** Relevant national and regional plans and strategies have been identified. The proposed project is broadly consistent with SADC plans and strategies. The proposal includes a summary for each participating country on the alignment with national climate strategies and plans, and with national sustainable development strategies and plans or poverty reduction strategies.	
	7. Does the project / programme meet the relevant national technical standards, where applicable, in compliance with the Environmental and Social Policy of the Fund?	**No.** Relevant national technical standards have not been identified in the proposal, and compliance with such standards is limited to a general statement of intent.	**CAR 3:** Text added in the Concept Note under **F – Relevant national technical standards** An additional Annex was added with additional relevant national standards – **Annex 3**

		CAR 3: Please identify the relevant national technical standards and state in a logical manner how compliance will be ensured.	
	8. Is there duplication of project / programme with other funding sources?	**Possibly.** The proposal lists a number of relevant and potentially overlapping projects and programmes. Key partners in the region have been listed and some opportunities for collaboration have been identified. At fully-developed stage, the proposal will need to provide comprehensive information on actual overlap with other funding sources, on linkages and synergies, highlighting complementarity and lessons learning from earlier initiatives.	
	9. Does the project / programme have a learning and knowledge management component to capture and feedback lessons?	**Yes.** The use of RBOs as vehicles for the development and management of transboundary aquifers limits the ability to learn for other TBAs to those where such RBOs are already in place. Please also see **CR7** below.	
	10. Has a consultative process taken place, and has it involved all key stakeholders, and vulnerable groups, including gender considerations in	**Partially.** The information provided focusses on plans for future consultations. Paragraph 118 states that a detailed stakeholder consultation plan will be developed to inform the funding proposal development. The consultations so far overall were limited to institutional stakeholders. Civil	**CR 5:** It was provided under I. and is captured as a Table in Section 121 of the Concept A Stakeholder Consultation Plan also provided as an Annex 7

	compliance with the Environmental and Social Policy and Gender Policy of the Fund?	society, NGOs and potential beneficiaries appear to have been almost absent from the consultations so far. The proposal contains no links to the documents presented in the 1-page Annex 3, and it was not possible to review the supplemental information. **CR 5:** Please provide the detailed stakeholder consultation plan, even if some specifics may still need to be included as a process, as well as the supplementary information, separately from the concept note.	
	11. Is the requested financing justified on the basis of full cost of adaptation reasoning?	**No.** The proposal demonstrates that the project activities are relevant in addressing its adaptation objectives and that, taken solely, without additional funding from other donors, they will help achieve these objectives. However, please see **CAR 1.**	**CAR 1:** Clarified above
	12. Is the project / program aligned with AF's results framework?	**Yes.**	
	13. Has the sustainability of the project/programme outcomes been taken into account when designing the project?	**Unclear.** As mentioned under question 4 above, sustainable groundwater extraction critically depends on established and performant monitoring of both extraction and the condition of the aquifer. The management arrangements at TBA level need to be sufficiently solid, and enforceable. If not, the proposed infrastructure investments could be used in unsustainable extraction and depletion of groundwater resources, constituting maladaptation. The	**CAR 4:** The project approach was changed to incorporate the modelling component, which will generate the information necessary to sustain the project outcomes. With better information on how the systems are running, sustainability is enhanced. Moreover, the inherent nature of activities implemented in Components 2 and 3 also draw direct socio-economic benefits to the project beneficiaries who would be inclined to

		required resolution of the monitoring network is not demonstrated, and given the size and transboundary nature of the resources, it is unlikely that the envisaged monitoring and subsequent management efforts will be adequate. Given their role in this, the RBOs will be critical and sustainability strongly depends on their performance, which is not demonstrated. It is unclear from the proposal how project outcomes will lead to scale up or how the TBA management arrangements will be financed post-project. The effectiveness and feasibility of the proposed mitigation measures presented in paragraph 124 are critical but not demonstrated – the proposal provides numerous arguments to the contrary. **CAR 4:** Please demonstrate the sustainability of the project/programme outcomes.	sustain the said benefits. As the approach elaborates, identifying the activities will be participatory to enhance ownership. The project proposes to drill a specified number of boreholes for monitoring purposes, but this does not determine the full scope of the monitoring network because existing boreholes in the project areas will also be equipped to serve as monitoring points. As indicated, LIMCOM and ZAMCOM RBOs are fully established with strong governance structures. However, due to the traditional bias on surface water, the SADC-GMI has been capacitating them over the years to build their competencies in groundwater. This project is a further vehicle to strengthen the RBOs that have already established Groundwater Committees and are in the process of developing Groundwater Strategies with the support of SADC-GMI
	14. Does the project / programme provide an overview of environmental and social impacts / risks identified, in compliance with the Environmental and Social Policy and	**No.** 1. USPs Over two thirds of the budget for project activities is allocated to Unidentified Sub-Projects (USPs). While there is an inherent justification in the theory of change for the use of USPs, this justification needs to be made	**CAR 5:** The approach has been significantly revised under CAR 1, and more clarity has been provided under Component 3 such that USPs have been minimized. **CAR 6:** The table on Pages 41-42 of the Concept Note presents the identification of environmental and

	Gender Policy of the Fund?	explicit, and the implications need to be reflected in the ESMP. Other than implementing activities of the (yet to be formulated) SAPs, there are no restrictions on the selection of USPs, leaving them fully unidentified in location, in nature and in inherent environmental and social risks. In line with the updated guidance on the use of USPs (AF Board Decision B.39/52, please see https://www.adaptation-fund.org/wp-content/uploads/2022/10/PPRC.30.54-Updated-guidance-on-USPs-with-Annex.pdf), USPs of such type are inadmissible and must not be included in a project/programme as USP. Being a regional project involving varying partners further compounds the challenge of complying with AF's ESP and GP. It seems that the executing entity (EE) will need to perform the role of the IE in supervising and monitoring AF safeguards and GP compliance by the numerous executing partners while its capacity to do so is not demonstrated and the requested budget to cover the execution costs is well below the allowed level. The claim that the IE's environmental and social assessment procedures would be fully aligned with the AF is irrelevant and only compliance with AF policies needs to be demonstrated in the proposal. **CAR 5:** Please revise the proposal to address the activities that are not admissible as USPs.	social risks, in line with OPG Annex 3, 4, 5 and Decision B.39/52. The high-level Gender Analysis conducted so far is a starting point to a comprehensive Gender Action Plan that will be populated during the Proposal development stage. The IE will apply part of the Proposal Preparation Grant to fulfill the requirements of these Annexes and the Decision **CR 6**: Section L in the Concept Note has been beefed up with additional basis for categorisation as Category B. The considerations of the project budget will entail small-scale initiatives with site specific ES impacts that will be identified through E&S screening and ESMPs after the project sites have been identified **CAR 7:** Addressed in the Concept Note and an initial Gender Analysis attached as an Annex 4. Part of the Proposal Preparation Grant will be used to fully comply with this requirement

		2. Risks identification The overview of environmental and social risks presented in II.L includes those related to the USPs and is mostly speculative. The presented identification of risks takes mitigation and management measures into account, which is not in line with the ESP. **CAR 6:** Please identify environmental and social risks, in line with OPG Annex 3, 4, 5 and Decision B.39/52. Based on the overview of risks, the proposal concludes that there are minimal, localized, and reversible environmental and social impacts, and that the project should therefore be considered category B. Whilst this conclusion may be accurate, it is not justified based on the information presented. **CR 6:** Please clarify the grounds for categorizing the project in terms of environmental and social risks, in line with the ESP. Compliance with the AF GP is limited to a few statements of intent. The role of gender in achieving the stated objectives and the opportunities for women's empowerment are largely missing. There is no reference to a gender analysis that has or will inform the project formulation. **CAR 7:** Please demonstrate that the project comply with the AF GP including a gender analysis and outline how it will comply with the	

		GP's requirements in the fully developed proposal.	
	15. Does the project promote new and innovative solutions to climate change adaptation, such as new approaches, technologies and mechanisms?	**Partially.** None of the proposed techniques for transboundary groundwater management appears to be new or innovative, even though elements of the data analysis may be innovative. There is no information on data analysis or the hydrological or hydrodynamic or other modelling techniques the project may use. The innovation aspect is limited to the approach being relatively new to the region. There is a clear missed opportunity for innovation in the project proposal. Institutionalization of the process of TBA management is the most critical part for which no single format or solution exists. Adding on TBA management to the remit of existing river basin management organisations is not new but is certainly not always a suitable arrangement. The proposal promotes the use of RBOs as the single vehicle for institutionalization of regional management of TBAs. At the same time, the constraints and the challenges and the failures of RBOs of managing the surface water resources for which they were established are mentioned. There may even be no physical link or a total mismatch between the river and the TBA. The opportunity for much needed innovation in establishing functional effective institutions for regional management of TBAs is entirely	**CR 7:** The project approach has been revised as per CAR 1 to include the development of Numerical models in the TBAs. As such, the innovation emanates from the collection and generation of data during the TDA processes, which will feed into the development of the said Numerical models to better understand the groundwater dynamics and its role to climate change adaptation and mitigation. Being transboundary in nature, it is critical that countries sharing TBAs have data protocols for data sharing; which data will feed into the models. RBOs like LIMCOM and ZAMCOM are being assisted by SADC-GMI to have Data Sharing Protocols which will enable the countries to share data necessary to manage the TBAs. ZAMCOM and LIMCOM will continue to be assisted through this project to operationalise their Data Management systems which are linked to the SADC Groundwater Information Portal (SADC-GIP). These data sharing needs also align with the institutional and governance linkages necessary for this project. The Multi-Country Cooperation Mechanism (of which one was recently established in Ramotswa TBA) will allow the riparian

		missed by replicating the process and structures of the RBOs. **CR 7:** Please clarify how the use of RBOs to institutionalize regional management of TBAs is innovative, and how the project will explore innovation in institutionalizing regional management of TBAs beyond RBOs.	countries at TBA to collaborate at TBA level and report its activities to the RBO's Technical Committees (through the Groundwater Committees) which are also comprised of RBO riparian state representatives. As would be expected, there are less countries sharing a TBA than an RBO. As such the linkage of MCCM to the RBO allows the knowledge management and upscaling of resilience practices vertically. Cross learning among RBOs is further facilitated through the SADC-GMI as the custodian regional Centre of Excellence for groundwater development and management. The institutionalization of these initiatives at regional level is provided in the Regional Strategic Action Plan (2021-2025) derived from the SADC Revised Protocol on Shared Watercourses (2000) which also established and mandated the RBOs and SADC-GMI
Resource Availability	1. Is the requested project / programme funding within the funding windows of the regional projects/programmes ?	**Unclear.** Part I states that the Amount of Financing Requested is "$13 932 000 million (in U.S Dollars Equivalent)". **CAR 8:** Please correct the amount of funding requested in Part I, i.e. remove the word "million".	**CAR8:** Corrected
	2. Are the administrative costs (Implementing	**Unclear.**	**CAR 9:** Corrected

	Entity Management Fee and Project/ Programme Execution Costs) at or below 10 per cent of the project/programme for implementing entity (IE) fees and at or below 10 per cent of the project/programme cost for the execution costs?	The budget included in the table presenting Project Components and Financing contains errors. **CAR 9:** Please provide a correct overview of project financing and breakdown of costs and confirm the amount of funding requested.	
Eligibility of IE	Is the project/programme submitted through an eligible Multilateral or Regional Implementing Entity that has been accredited by the Board?	**Yes.**	
Implementation Arrangements	• Is there adequate arrangement for project / programme management at the regional and national level, including coordination arrangements within countries and among them? Has the potential	n/a at concept stage	

	to partner with national institutions, and when possible, national implementing entities (NIEs), been considered, and included in the management arrangements?		
	• Are there measures for financial and project/programme risk management?	n/a at concept stage	
	• Are there measures in place for the management of for environmental and social risks, in line with the Environmental and Social Policy and Gender Policy of the Fund? Proponents are encouraged to refer to the Guidance document for Implementing Entities on	n/a at concept stage	

	compliance with the Adaptation Fund Environmental and Social Policy, for details.		
	• Is a budget on the Implementing Entity Management Fee use included?	n/a at concept stage	
	• Is an explanation and a breakdown of the execution costs included?	n/a at concept stage	
	• Is a detailed budget including budget notes included?	n/a at concept stage	
	• Are arrangements for monitoring and evaluation clearly defined, including budgeted M&E plans and sex-disaggregated data, targets and indicators, in compliance with the Gender Policy of the Fund?	n/a at concept stage	
	• Does the M&E Framework include a break-down of how implementing	n/a at concept stage	

	entity IE fees will be utilized in the supervision of the M&E function?		
	• Does the project/programme's results framework align with the AF's results framework? Does it include at least one core outcome indicator from the Fund's results framework?	n/a at concept stage	
	• Is a disbursement schedule with time-bound milestones included?	n/a at concept stage	

CONCEPT NOTE FOR REGIONAL PROGRAMME

PART I: PROGRAMME INFORMATION

Title of Project:	Enhancing Water and Food Security through Sustainable Groundwater Development in the SADC Region
Countries:	Botswana, South Africa, Mozambique, Zimbabwe, Malawi and Zambia
Thematic Focal Area[1]:	Transboundary water management
Type of Implementing Entity:	Multilateral Implementing Entity
Implementing Entity:	International Fund for Agricultural Development
Executing Entities:	SADC Groundwater Management Institute
Amount of Financing Requested:	$13 932 000 ~~million~~ (in U.S Dollars Equivalent)
Project Formulation Grant Request:	Yes ☒~~☒~~ No ☐☐

Amount of Requested financing for PFG: 50,000 (in U.S Dollars Equivalent)

Letters of Endorsement (LOE) signed for all countries: Yes ☒☒ No ☐☐

NOTE: LOEs should be signed by the Designated Authority (DA). The signatory DA must be on file with the Adaptation Fund. To find the DA currently on file check this page: https://www.adaptation-fund.org/apply-funding/designated-authorities

Stage of Submission:

☒~~☒~~ This proposal has been submitted before including at a different stage (pre-concept, concept)

☐~~☐~~ This is the first submission ever of the proposal at any stage

In case of a resubmission, please indicate the last submission date: 5/31/2022

Please note that the Concept note proposal document should not exceed 50 pages, including annexes.

[1] Thematic areas are: Food security; Disaster risk reduction and early warning systems; Transboundary water management; Innovation in adaptation finance.

Project Background and Context:

1. Currently, only 6% of the total cultivated area in Africa is irrigated. Across the region, the irrigation potential from groundwater is grossly underutilised. It has been estimated that irrigation could boost agricultural productivity by 50%, bringing significant resilience to rural livelihoods. Moreover, population growth and economic development will increase the demand for water across Sub-Saharan Africa (including Southern Africa), currently at around 50 litres per person, compared to 10 times that amount in the USA[2].

Figure 1. Transboundary aquifers of Southern Africa.

2. In Southern Africa, it is estimated that at least 70% of the regional population relyrelies on groundwater as their primary water source. It is not only used for drinking and sanitation, but also to support the primary livelihood in the region, smallholder farming. However, unmanaged use of groundwater by competing sectors can be dangerous to those that relygroundwater use by competing sectors can lead to maladaptation on it. ExpandingBy Eexpanding industries,y there is potential toExpanding industry is to drawing down aquifergroundwater levels, and pollution of the aquifers from agriculture and mining adds to the growing concerns[3]. As agriculture in Southern Africa is predominantly rainfed (except for wheat-producing areas in South Africa), the region's population is inherently vulnerable to climate variability and change. Comprehensive adaptation actions are required to ensure water security for Africa's most vulnerable smallholder farmers in the face of climate change.

3. Changes in water quality and availability The predictions are that climate change will be the dominant changes seen under future climate scenarios in significantly impact water resources globally and in Southern Africa, with more frequent surface-water droughts and extreme rainfall events. For example, stream flows for the Limpopo and Okavango catchments are projected to decrease by 35% and 20%, respectively. Safeguarding and providing water storage capacity is crucial for climate adaptation as it provides a buffer against floods and droughts, and balances increasing water variability., and compensates for the loss of natural water storage systems, such as glaciers and wetlands. Groundwater has displayed drought resilience in the past, and the presence of aquifers (with their large volumes of stored water) provides a natural solution for deployment in climate-change adaptation. Therefore, groundwater management widely requires strategic rethinking to ensure resource reliability for climate-change adaptation, with increased investment in conjunctive use, managed aquifer recharge, demand-side/supply-side management, and quality protection. The critical criteria determining an aquifer's potential role in climate change adaptation are storage availability, supply productivity, natural quality and pollution vulnerability. There remains uncertainty over the long-term effects of climate change on groundwater recharge, storage and discharge in different regions, but global warming could lead to reduced groundwater recharge, impacting the reserves of low-storage shallow aquifers[4] (IAH 2019). Projected and continuing changes to the amount, intensity and predictability of rainfall in much of Southern Africa due to climate change will lead to changes in how the region views its

[2] Source: https://www.un.org/waterforlifedecade/africa.shtml
[3] Source: https://www.worldbank.org/en/news/feature/2017/06/07/hidden-and-forgotten-managing-groundwater-in-southern-africa
[4] Source: https://iah.org/wp-content/uploads/2019/07/IAH_Climate-ChangeAdaptationGdwtr.pdf

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Field Code Changed

groundwater resources to support climate resilience . The challenges of a dynamic and declining water availability situation under future climate projections will lead to greater pressure to exploit unrealised and little-known groundwater resources, particularly for rural smallholder farmers who will be under pressure from competing water users such as commercial agriculture, urban development and energy production (the Nexus challenge).~~Changes in water quality and availability will be the dominant changes seen under future climate scenarios in Southern Africa. For example, stream flows for the Limpopo and Okavango catchments are projected to decrease by 35% and 20%, respectively. As such, transboundary water management presents a unique opportunity and challenge to the region. Southern Africa's water resources include several transboundary aquifers and are unevenly distributed, both seasonally and geographically. A majority of the region has supply deficits during at least part of the year, presenting a limiting factor for development. Rising demands and increasing pollution levels across shared water resources are critical problems. Droughts and floods are normal events in the region's climate context. Infrastructural developments intended to safeguard water supplies have increased the geographical unbalance of water resources, as many dams have been built to store water during unpredictable and often long dry periods, particularly in South Africa and Zimbabwe. Inadequate extent and maintenance of existing water infrastructure, unclear mandates for shared watercourse institutions and limited institutional capacity all hamper transboundary water management, particularly under climate change conditions. Projected and continuing changes to the amount, intensity and predictability of rainfall in much of Southern Africa due to climate change will lead to changes in how the region views its groundwater resources to support climate resilience[5]. The challenges of a dynamic and declining water availability situation under future climate projections will lead to greater pressure to exploit unrealised and little-known groundwater resources, particularly for rural smallholder farmers who will be under pressure from competing water users such as commercial agriculture, urban development and energy production (the Nexus challenge).~~

4. The existence of over 30 Transboundary Aquifers (TBA) in Southern Africa presents both a climate change adaptation opportunity and an institutional and management challenge (Figure 1)[6]. ~~The coordinated~~Coordinating governance and groundwater use at the regional level for climate change adaptation makes sense. Whilst holding a significant proportion of the region's water resources, with ~~built~~ built in natural resilience against increasing temperatures~~,~~ (groundwater is estimated to be 35% of the total water available in SADC (7,199 m^3)~~).~~)~~ there are no established transboundary cooperation and collaboration mechanisms to govern, monitor and manage their sustainable utilisation. Additionally, while some Southern African states are integrating groundwater into their water resource management policies, ~~institutional~~ governance and management frameworks to manage water at ~~both~~ national and regional levels still do not adequately incorporate groundwater. For example, information systems to measure and manage groundwater ~~are different~~differ from country to country, while institutions to manage groundwater have limited capacity, suffering from scarce financial and human resources. River Basin Organisations (RBOs) represent emerging good practices~~practice~~ for transboundary surface water governance. Groundwater ~~will r~~requires~~require~~ similar transboundary cooperation and collaboration~~,~~ agreements and governance~~, agreement~~ and management arrangements for the region to be able to utilise the shared resources as a climate change adaptation response in a sustainable manner. It will ~~be ultimately self-defeating if one country implements a sustainable groundwater use and recharge policy in a shared aquifer whilst another abstracts with little regard~~

~~[5] Source~~

[6] Nijsten, GJ. et al. 2018. Transboundary aquifers of Africa: Review of the current state of knowledge and progress towards sustainable development and management. *Journal of Hydrology: Regional Studies*. Volume 20, pages 21-34. https://doi.org/10.1016/j.ejrh.2018.03.004

toultimately be self-defeating if one country implements a sustainable groundwater use and recharge policy in a shared aquifer whilst another abstract has little regard for the future.

5. The SADC Groundwater Management Institute (SADC-GMI) will execute this project to address the challenges described aboveabovementioned challenges. IThe SADC-GMI is an interlocutor with national governments and regional and international groundwater initiatives and institutions. As the regional Centre of Excellence for sustainable development and management of groundwater resources in SADC, SADC-GMI carries the mandate to upscale these types of initiatives to build the communities' resilience to climate change impacts. One of the key impediments to achieving resilience is the absence of data. SADC-GMI hosts a SADC Groundwater Information Portal (SADC-GIP), which will serve as a repository and share the data generated from this initiative required to generate regional knowledge on adaptation measures to the impacts of climate change. Moreover, SADC-GMI runs annual SADC Groundwater Conferences where regional knowledge and research results are shared. SADC-GMI also has a training calendar on several topics, including the sustainable use of groundwater to support resilient livelihood approaches under climate change impacts. With these offerings, SADC-GMI's value proposition as the executing agency of this regional initiative is invaluable as the only regional institution that enjoys credible recognition from all the 16 SADC Member countries that variously share TBAs amongst themselves.

5.6. It is projected that 1,361,995 beneficiaries living in TBA areas would become more climate resilient and enjoy improved water, food and livelihood security from the sustainable, cooperative and equitable use of transboundary groundwater resources. The sustainable use of groundwater resources will also contribute to reducing poverty levels in these areas, which are high.

7. From henceforth, sustainable groundwater management in this proposal is defined as the development and use of groundwater resources to meet current and future beneficial uses, including to support climate change adaptation, without causing unacceptable environmental or socioeconomic consequences (e.g., maladaptation). Sustainable groundwater management gives assurance that groundwater will be available for future generations. In some instances, groundwater storage has been established over many years of rainfall, and although it can be considered a renewable resource, it can be depleted in the long term if not properly correctly managed. Understanding the state (quantity and quality of available supply, and demand) of groundwater source areas is critical in groundwater management. The adage "you cannot manage what you do not measure" applies to the management of groundwater resources. Unmonitored abstraction and over-exploitation of groundwater persist and poses a risk to the sustainability of the resource. In areas of large scale groundwater use, boreholes have been known to pump dry, some temporarily, due to lack of insight on the aquifer storage capacity and subsequent over abstraction. Globally there have been many cases of groundwater depletion (in China, India, Pakistan and the USA) driven mainly by irrigated agriculture. However, in sub-Saharan Africa, in most countries, the current groundwater use remains under 5% of the national sustainable yield suggesting that groundwater has the potential to be a foundational resource to support irrigated agriculture, urban and rural water security, and drought resilience across the region, as it has in many other global regions.

6. Sustainable groundwater use requires effective management that goes beyond monitoring groundwater abstraction volume, and incorporating water levels and quality moniotoring. However, investment in resource management is often seriously neglected. In the absence of management, and with ongoing resource development, the consequences include contamination and salinization of groundwater, land subsidence, decreasing water tables and reduction in groundwater contribution to groundwater dependent ecosystems. Suppose borehole yield (volume) and level is monitored together; in that case, the aquifer response to abstraction is better

~~understood, enabling optimisation of pumping rates and duration. Monitoring groundwater quality in abstraction boreholes assists in identifying changes in aquifer water chemistry, and the possible drawing in of water from adjacent aquifers or surface water features.~~

~~7.~~8. Four transboundary aquifers in the SADC region have been prioritised in this proposal. These are the Tuli Karoo Sub-Basin, Ramotswa /Zeerust/ Lobatse Dolomite Basin Aquifer~~Ramotswa~~, Sand and Gravel and the Limpopo Basin Aquifers. More information is provided on the reason for selection and the characteristics of the aquifers. The aquifers are in various stages of development, as illustrated in ~~the~~ Figure 2.

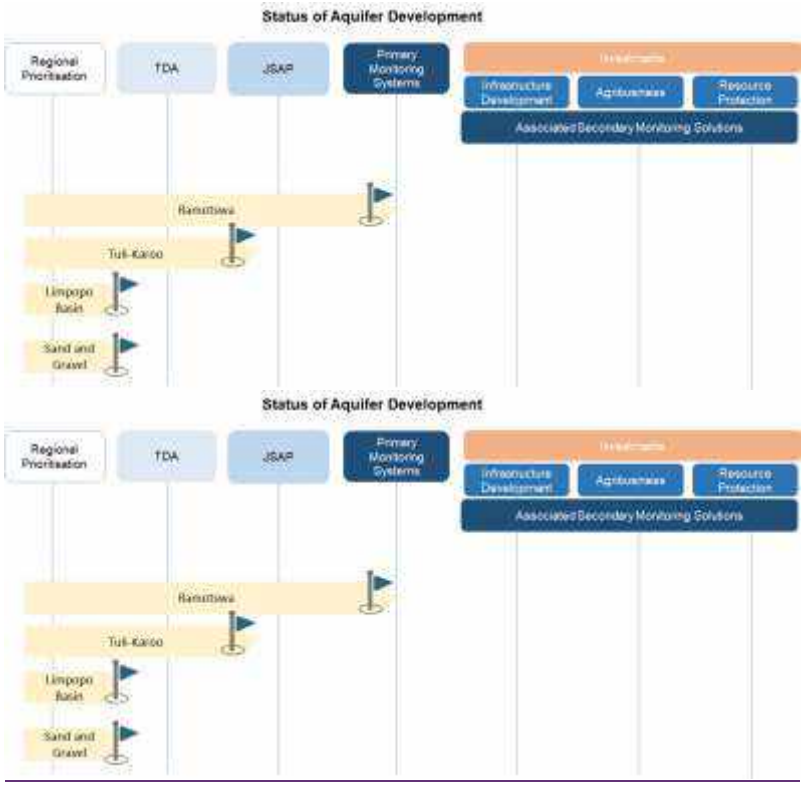


Figure 2. Aquifer Development Status.

Project Location and Climate Rationale

~~8. Of the 27 transboundary aquifers in the SADC region that still need to be researched where there is no data to inform sustainable abstraction, or where it has yet to be developed, three have been carefully selected as priorities for development.~~

~~10.~~9. Firstly, priority was given to those aquifers where the TDA process has already been undertaken and a SAP developed, as these represent “quick wins” where countries are engaged and already on the journey of developing their shared groundwater. In this situation, the SAP has

prioritised the needed actions, which have been agreed by each member state sharing the aquifer, and technical assistance to implement the SAP can begin almost immediately. Infrastructure can be designed and constructed, and technical assistance to develop governance mechanisms and build local management capacity can begin.

~~11.~~10. In the SADC Region, only Ramotswa is in this position. Following the TDA in December 2016, a SAP was completed in 2019 and endorsed by the two riparian Member States of Botswana and South Africa during the Ramotswa 2 Project Closure workshop held in Gaborone, Botswana, from 9-11 April 2019.

~~12.~~11. Of the remaining 26 aquifers that have not been researched, the Sand and Gravel Aquifer and Limpopo Basin are prioritised in this project as these are the most vulnerable to projected future climate change in Southern Africa[7]. There is significant potential to bring about large impacts in supporting agriculture, food security and livelihoods in ~~these~~ these two climate and ~~water~~ water-stressed ~~lower~~ lower-income areas.

~~13.~~12. Climate vulnerability was assessed using the SADC Groundwater Information Portal. This public GIS tool contains hydrological, climatic and demographic data for Southern Africa[8]. This allows the overlay of transboundary aquifers with climate vulnerability maps and identifies the aquifers at the highest vulnerability to projected climate change. It also allows interrogation of the population and identification of aquifers with the largest number of potential beneficiaries. Through this, the Sand and Gravel Aquifer and Limpopo Basin aquifer were selected.

~~14.~~13. The Tuli-Karoo is the fourth aquifer selected in this project. The aquifer is next to the Limpopo Basin Aquifer. It is similarly one of the ~~most vulnerable aquifers to climate change in the region.~~region's most vulnerable aquifers to climate change. ~~.~~ It has also started its development, and some initial work has been undertaken. The TDA will be published in the coming months, and initial work on the SAP has been started.

~~15.~~14. The interactions between surface water and groundwater ~~is~~ are acknowledged in the SADC water policies. RBOs in the SADC region~~, therefore,~~ subscribe to the principle of conjunctive groundwater and surface water management. They have established working relationships with the SADC-GMI~~, through signing of~~ by signing the Memoranda of Understanding. Therefore, the ~~The~~ proposed project will be implemented within the same guiding principles, with the active involvement of RBOs (LIMCOM and ZAMCOM). ~~Both LIMCOM and ZAMCOM are fully functional, politically and technically consistent with their mandate in the Agreements and they~~LIMCOM and ZAMCOM are fully functional, politically and technically consistent with their mandate in the Agreements and will be able to ~~adequately support and sustain the project activities.~~support and sustain the project activities adequately. ~~.~~ The SADC region's governance mechanisms also ascertain the functionality of these RBOs through the Water Resources Technical Committee, where the RBOs report at least twice annually, as well as through the technical oversight provided by the SADC Secretariat's Water Division. Both RBOs have the technical capacities required to support the project activities. SADC-GMI, as the Technical Advisor to the RBOs, will also complement the capabilities needed capacities for effective project implementation.

~~16.~~15. Figure 3 shows the location of the four target aquifers superimposed on national and river basin boundaries. In addition, they are ~~also generally geophysical and~~

[7] Villholth et al (2013) Integrated mapping of groundwater drought risk in the Southern African Development Community (SADC) region. Hydrogeology Journal, vol. 21(4), pp 863-885

[8] https://apps.geodan.nl/igrac/qgis-viewer/viewer/sadcgip/public/default https://apps.geodan.nl/igrac/qgis-viewer/viewer/sadcgip/public/default

~~hydrologically representative of other aquifers and governance arrangements and Government commitment are~~generally geophysical and hydrologically representative of other aquifers, and governance arrangements and Government commitment are also supportive. They~~.~~ are, therefore, strong pilot projects that provide a foundation for replicating and upscaling to other aquifers across Southern Africa in a possible Phase 2.

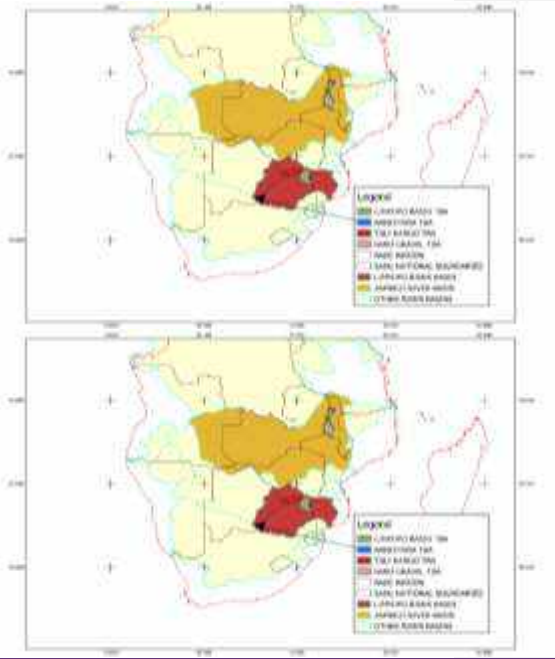


Figure 3: Targeted Transboundary Aquifers superimposed on River Basins.

The transboundary aquifers of focus are presented in the table below

. Name	Countries Sharing TBA	Area (km²)	Estimated population
Ramotswa Aquifer	Botswana and South Africa	190	[9]694,995
Limpopo Basin Aquifer	Mozambique, South Africa, Zimbabwe	17,000	460,000
Sand and Gravel Aquifer	Malawi, Zambia	22,000	83,600
Tuli Karoo Sub-Basin	Botswana, South Africa, Zimbabwe	12 000	123 400
Total		**51 190 km²**	**1,361,995 people**

~~17.~~16. The following paragraphs summarise the climate change impact and vulnerability in the Tuli Karoo, Limpopo Basin, Ramotswa and Sand and Gravel TBAs. The summaries are based on data sourced through two methodologies: three future climate scenarios based on Self Organising Maps (SoMs) and a review of the current scientific literature on climate change impact relevant to southern Africa.

~~18.~~17. The presented scenarios depict the possible climate futures for a transboundary river basin, related to the a~~foremention aquifers.~~guifers mentioned above.~~.~~ These scenarios are based on

[9] Based on delineation provided by *Yvan Altchenko, Nicole Lefore, Karen G. Villholth, Girma Ebrahim, Andrew Genco, et al. (2016). Resilience in the Limpopo Basin: The potential role of the transboundary Ramotswa aquifer - Baseline report. [Research Report] USAID Southern Africa. 2016. hal-02329714.* Study Area Included Gaborone, Lobatse, Ramotswa, Tlokweng, Kanye and Ngwaketse

an analysis of over 35 Global Climate Models that cover the relevant basin. They use a statistical technique called Self Organising Maps (SoMs), which acts like a neural network to identify the more likely climate pathways in the future. This methodology helps manage some ~~of the~~ uncertainty related to climate models and projections.

~~19.~~18. Both the literature review and the SoMs methodology were previously applied by the Climate Resilient Infrastructure Development Facility (CRIDF) to feed climate vulnerabilIty analysis of several transboundary basins in Southern Africa. The data is drawn from the *CRIDF Paper Southern Africa Projections and Impacts Guidance Paper (2018, updated 2020)*.

TULI KAROO TBA, LIMPOPO TBA AND RAMOTSWA TBA

SoMs for Tuli Karoo TBA, Limpopo TBA:

~~20.~~19. The scenarios elaborated for the Limpopo River Basin can help to understand the climate change impact on the Tuli Karoo and the Limpopo Basin TBAs.

~~21.~~20. The first scenario shows higher temperatures and less rainfall in the basin between the 2040s and 2080s. In the border area, the temperature increases slightly more by 1.25°C in the 2040s, rising to 2.50°C in the 2080s. In the east of the basin, close to Mozambique, the temperature will increase by 2.00°C above the baseline by the 2080s. Rainfall, for most of the basin, will decrease, ranging between 10 and 25% in the 2040s, which remain similar in the 2060s and 80s with significant reductions of around 15-20%.

~~22.~~21. Temperature increases in the second scenario are slightly less than in Scenario 1, averaging around 2.00°C, although the most significant increase is still in the order of magnitude of 2.50°C degrees. However, other domains see less temperature increases of roughly 1.50°C - 1.75°C rather than 2.00°C in scenario 1. ~~In terms of rainfall less evaporation there are large differences across the basi~~There are large differences across the basin~~.~~ in terms of rainfall and less evaporation.~~.~~ In the East of the basin, there are significant increases in rainfall (Mozambique) where precipitation less evaporation could be 50% higher by the 2040s and 75% higher by the 2080s (however, this scenario is less likely than the first scenario (30%). The border area between South Africa, Zimbabwe and Botswana shows~~show~~ around a 5-10% increase in precipitation, rising to 10-25% in the 2060s and up to 30% in the confluence area in the 2080s.

~~23.~~22. The ~~third scenario, the less probable,~~less probable third scenario shows a much higher temperature and less rainfall. This scenario shows a steadily increasing temperature throughout the century, rising to over 40°C in some places by the 2080s. The precipitation reductions are similar to scenario two; thus, ~~and thus~~ water availability decreases to less than 50% of the 1986 – 2006 baseline. The likelihood of extreme temperatures in the future, defined as 3-year consecutive years in any one decade of having a temperature three standard deviations from the 1986-2006 average temperatures, increases between 0 and 17%. The likelihood of 3 years of consecutive drought equivalent to the 25 percentile changes slightly by 0 - 5% increases.

~~24.~~23. The likelihood of extreme multiyear events such as heatwaves would increase, the frequency of drought events will increase, and wetter year frequencies will decrease in all three scenarios.

SoMs for Ramotswa TBA:

~~25.~~24. Projections of the western part of the Limpopo River Basin, the Waterberg area, are relevant to understand the climate change impact on the Ramotswa TBA. According to the first scenario, the temperature increases in the 2040s by 1.25°C, which rises to 2.00°C by the 2080s. In terms of rainfall, the Waterberg area shows roughly similar rain less evaporation as there is today, with a slight increase of about 5% in the 2060s. In the second scenario, this domain of the Limpopo Basin shows a significant decrease in ~~rainfall~~ rainfall ~~less~~ less evaporation, going from a 20% reduction in the 2040s to a 40% reduction in the 2080s. The third scenario, with only a 5% likelihood, shows a much more substantial increase in temperature. They will increase by 1.50°C in the 2040s and rise to 4.00°C in the 2080s, ~~and a substantial decrease in rainfall, which is~~with a substantial decrease in rainfall, projected to decrease by 40% in the 2040s. As for the other domains of the Limpopo river basin, the likelihood of ~~multiyear extreme~~extreme multiyear events such as heatwaves would increase, the frequency of drought events will increase, and wetter year frequencies will decrease in all ~~the~~ three scenarios.

Hydrological impacts

~~26.~~25. Projections for climate change impact in ~~the region of~~ Limpopo Basin TBA, Tuli Karoo TBA and Ramotswa TBA suggest that the aridity of desert and semiarid environments will persist in the future. The west of the country will probably experience a decrease in rainfall, which will reach 20% in parts by 2025. Projections for 2055 show more severe aridity cond~~i~~itions with increased wind erosion, migration of sand dunes, decreased air quality and pollution~~. Increased water demand may lead to unsustainable borehole extraction, causing a decrease of the groundwater table~~. Some ephemeral rivers will become permanently dry, and perennial rivers may become ephemeral. ~~Groundwater recharge will be reduced under all scenarios, and general water supply. Frequency.~~ The frequency of drought and heatwave events are also expected to increase by 2025, and soil moisture anomalies may negatively affect agriculture systems and sustainability in the area by 2055. Indeed, by 2055, increased aridity may result in more severe food insecurity, increased spread of invasive plant and insect species and loss of rainfed agriculture, making subsistence agricultural systems less viable. Also, the reducing reduction in~~reducing~~~~reduction~~ surface water availability may result in higher health and sanitation risk.

SoMs SAND AND GRAVEL TBA

26. Projections on the Lake Malawi basin elaborated with the SoMs methodology are useful to understand the climate change impact on the Sand and Gravel aquifer.

27. The first scenario shows higher temperatures and less rainfall. Steady temperature increases throughout the century from 1.50°C in 2030 to 2.00°C by 2080. Precipitation less evaporation in the early season reduces throughout the century~~, from. F~~, from~~From~~ 5% in 2030 to 15% by 2080. However, the later season sees a slight increase in rainfall of 5% by 2060 and 10% by 2080. In terms of the extremes indices they suggest a decrease in wet spells and an increase in dry spells by perhaps by 5-10% in both cases. In short, extended periods of heat, longer dry spells, briefer wet spells, and sometimes heavier rainfall events when these occur can be expected. The earlier season will be affected more than the latter~~later~~ by extended warm and dry spells~~, and also reduced wet spells; most likely, any changes in rainfall intensity would be distributed throughout the rainfall~~ and reduced wet spells; most likely, any changes in rainfall intensity will be distributed throughout the season.~~season.~~ This scenario suggests a ~~greater~~ more significant difference in the climate than the average from the literature.

28. The second scenario shows higher temperatures but more rainfall. There is a rise in temperature in the second half of the century but slightly less than in scenario 1. (1.25°C in 2060 to 1.50°C by 2080). Precipitation less evaporation in the early season increases in the second

half of the century by 5% in the 2060s and 10% by the 2080s. However, the later season sees no change in rainfall and less evaporation throughout the century. In terms of the extreme indices, they suggest a decrease in wet spells and an increase in dry spells by perhaps 5-10% in both cases. However, as the temperature is less than in scenario one, this is expected to exhibit less change. In short, extended periods of heat, longer dry spells, briefer wet spells, and sometimes heavier rainfall events when these occur can be expected.

29. The third scenario shows ~~a slight increase in temperature is expected by the 2030s~~the 2030s expect a slight increase in temperature, however, by the 2060s, this grows to 2.50°C and 3.50°C by the 2050s. Precipitation will remain the same by 2030 but decrease significantly by 2060 (20%) and by 2080 (30%). The extremes indices are likely to exhibit a more extreme version of the same trends mentioned in Scenarios 1 and 2.

Hydrological impacts

30. Projections for climate change impact in the region of Sand Gravel TBA suggest more erratic precipitation and temperature regimes, likely increasing~~would likely increase~~ extreme flood and drought events by 2025. The ~~likelihood, the severity and duration of these events~~se events' likelihood, severity and duration will ~~further~~ increase by 2055, worsening the area's climate vulnerability. By 2055, increased overall drying trend and decreased winter rains result in decreased food production, land surface degradation and soil erosion due to increased aridity and soil moisture loss. Climate vulnerability is also worsened by increased deforestation and biodiversity loss. Rain-fed agriculture will likely be less reliable in many areas, and irrigated agriculture will become more significant, thereby increasing pressure on water resources and posing problems for ~~famers'~~ farmers' access to technology, investment and training.

Groundwater implications

31. Understanding how climate change affects groundwater resources in the TBAs, identifying potential risk areas, determining the implications for these vulnerable areas, and developing mitigation and adaptation strategies are complex. Attributing observed changes in groundwater level, storage, discharge, and quality to climatic changes has proven difficult in most parts of the world because of inadequate monitoring systems for modelling and validation. However, the projected impacts include the following: Groundwater recharge changes, Groundwater quantity changes (storage changes), Changes in discharge and groundwater-surface water interaction patterns, Groundwater quality degradation, and Groundwater-dependent ecosystems (GDEs) changes.

32. The recharge of aquifers in semi-arid areas such as SADC is episodic and increasingly dominated by focused recharge, such as flood events[10][11]. The observations of hyetograph-hydrograph responses from the semi-arid regions show that water levels respond after overcoming a certain precipitation threshold. This threshold can be (i) a series of individual precipitation events which forms part of a prevailing regional weather system and (ii) a single, heavy precipitation event over a short period like the rain-week patterns. This means future changes in variability are more critical than mean precipitation. The assumption that climate change reduces groundwater resources significantly requires more observation-driven research[11]. Due to extreme annual precipitation, groundwater recharge to many large-scale

[10] van Wyk E (2010) Estimation of episodic groundwater recharge in semi-arid fractured hard rock aquifers. University of the Free State

[11] Cuthbert MO, Taylor RG, Favreau G, et al (2019) Observed controls on resilience of groundwater to climate variability in sub-Saharan Africa. Nature 572:230–234. https://doi.org/10.1038/s41586-019-1441-7

aquifer systems may increase under climate change. However, the magnitude of this increase is unlikely to offset the impact of human withdrawals in areas of intensive abstraction. Understanding groundwater storage changes due to drought conditions are also significant and needs more research. Gravity Recovery and Climate Experiment (GRACE)-analysis of large groundwater systems in Africa does not show a natural reduction in groundwater storage, but the small-scale analysis may mask local-scale effects[12]. Understanding the potential anthropogenic impacts becomes critical, and integrated hydrological models are required. Groundwater discharge can include direct evaporation and transpiration and groundwater flow to the surface, including discharge to wetlands and rivers. In many hydrogeologic settings, groundwater discharges help to sustain surface waters during periods of low or no rainfall by sustaining baseflow. The modified recharge, discharge and groundwater levels affect GDEs as the anticipated changes will be beyond ranges of normal fluctuation. The climate is expected to affect input (recharge) and output (discharge) and influence groundwater quality. The temperature sensitivity of chemical and biological processes seems to indicate that small temperature changes driven by current warming should have a detectable effect on the ecology of aquifers and the composition of groundwater itself.

Barriers to the sustainable, cooperative and equitable use of transboundary groundwater resources for climate change adaption in Southern Africa

- Lack of established transboundary collaboration and cooperation mechanisms and plans to govern, monitor and manage the sustainable utilisation of TBAs in a coordinated manner.
- Limited technical knowledge and understanding of the baseline status of transboundary groundwater resources and ~~under~~ future climate scenarios to inform policy development and investment ~~decision~~ decision-making at the national and regional levels~~level~~.
- National institutions with mandates to manage groundwater have limited financial, technical and human resource capacity.
- Currently, groundwater monitoring in the region is variable, with some countries ~~maintaining~~ monitoring boreholes~~,~~ while other ~~countries are lackings~~ lack monitoring altogether. This creates unbalanced monitoring data for a transboundary aquifer, where two or three countries may be extracting groundwater from the same source, which is detrimental to decision-making for sustainable groundwater management and use, particularly for climate change adaptation.
- Limited understanding of the impacts of groundwater over-abstraction and catchment degradation on the diversification and improvement of community livelihoods in the face of the changing climate. This, in turn, limits ~~and~~ access to climate-resilient measures and infrastructure for the sustainable use of groundwater resources by farmers and agribusinesses to adapt to a changing climate.

Programme Objectives:

~~31.~~33. **Impact Goal:** To support sustainable ~~sustainable~~ and cooperative management of transboundary groundwater to strengthen the climate resilience of agriculture and agribusiness in TBA areas of Southern Africa through an evidence-based approach.

Programme Objectives:

[12] Bonsor HC, Shamsudduha M, Marchant BP, et al (2018) Seasonal and Decadal Groundwater Changes in African Sedimentary Aquifers Estimated Using. Remote Sens (Basel) 10:1–20. https://doi.org/10.3390/rs10060904

1. To conduct physical and environmental technical assessments to~~To~~ increase technical knowledge and understanding of transboundary groundwater resources both now and under future climate scenarios through performing TDAs and numerical analysis to inform policy development and investment ~~decision~~ decision-making at national and regional levels~~level~~ in the SADC Member States.
2. To develop strong and mutually agreed governance and cooperation frameworks, strategies and policies~~,~~ through a ~~common~~ shared understanding and ~~joint~~ collaborative planning processes by developing ~~and implementing~~ Joint Strategic Action Plans (SAPs) for sustainable use, management and protection of shared groundwater resources by SADC Member States.
3. To strengthen the capacity of water and land management institutions in the selected TBAs through the development of information systems that provide robust, real-time data that can be used for investment decisions, domestic, agricultural and resource protection/payment for ecosystem services purposes for equitable access in a changing climate.
4. To diversify and strengthen the livelihoods of most vulnerable communities through piloting and demonstrating~~e~~ concrete climate change adaptation measures based on sustainable land and groundwater utilisation ~~to diversify and strengthen the livelihoods of the most vulnerable population in To develop equitable, fair and climate resilient access to groundwater resources for smallholder farmers and agribusiness to increase agricultural productivity, income and support resilient livelihoods in local Resilience Hubs in the TBA~~TBA's most vulnerable population in local Resilience Hubs.

Project Components and Financing

Project Components[13]	Expected Outputs and Indicative Activities	Expected Outcomes	Countries	Amount (US$)
Component 1: Data, information and knowledge for transboundary groundwater management policy and decision making	**Output 1.1**: TDAs for the Limpopo Basin and Sand and Gravel Aquifers developed Activity 1.1.1: Conduct a TDA for the Limpopo Basin Aquifer. Activity 1.1.2: Conduct a TDA for the Sand and Gravel Aquifer. **Output 1.2**. ~~Construct~~ Nn~~u~~merical groundwater models for the Ramotswa TBA constructed, Tuli-Karoo Sub-basin, Limpopo Basin and Sand and Gravel Aquifer Activity 1.2.1 Groundwater model for the Ramotswa TBA Activity 1.2.2 Groundwater model for the Tuli-Karoo Sub-basin Activity 1.2.3 Groundwater model for the ~~-~~Limpopo Basin Activity 1.2.4 Groundwater model for the ~~-~~Sand and Gravel Aquifer **Output 1.~~2~~3**: 48 monitoring boreholes established, and data on groundwater in SADC's transboundary aquifers collected and collated via the GMI's Groundwater Information Portal Activity 1.~~3~~2.1: Establish automatic 48 monitoring boreholes to collect data on groundwater quality and quantity across SADC's TBAs. Activity 1.~~3~~2.2: Collect, collate and share data from the monitoring boreholes via the GMI's Groundwater Information Portal.	**Outcome 1**: Policy makers and the agricultural sectors have robust, scientific and reliable data to enable ~~decision~~ decision-making on transboundary groundwater management and investments	**All aquifers~~/~~countries**	$2 500,000
Component 2: Joint Strategic Action Plans (JSAPs) for climate-responsive governance, management and use of TBA groundwater resources	**Output 2.1**: JSAPs developed for the Limpopo Basin and Sand and Gravel Aquifers Activity 2.1.1: Conduct stakeholder consultations to inform the development of the JSAPs. Activity 2.1.2: Develop and validate a JSAP for the Limpopo Basin Aquifer. Activity 2.1.3: Develop and validate a JSAP for the Sand and Gravel Aquifer. **Output 2.2**: Ramotswa JSAP updated to support climate-resilient agriculture and agribusiness Activity 2.2.1: Conduct stakeholder consultations to prioritise ~~inform~~ the integration of water-related adaptation options for agriculture and agribusiness into the Ramotswa JSAP. Activity 2.2.2: Integrate prioritised water-related adaptation options for agriculture and agribusiness into the Ramotswa JSAP. **Output 2.3**: Capacity built for improved governance of the Ramotswa Aquifer to support the sustainable implementation of the JSAP's water-related adaptation options for agriculture and agribusiness	**Outcome 2**: Greater capacity of transboundary and ~~country~~ country-level institutions to govern and manage TBAs for climate-resilient agricultural development and increased participation by the wider stakeholder community, who are aware of water resource management issues and have access to tailored	**Limpopo Basin Aquifer:** Mozambique, South Africa, Zimbabwe **Sand and Gravel Aquifer:** Malawi and Zambia **Ramotswa Aquifer:** Botswana	$1,720,000

[13] Refer to project description for additional details of Components 1-3

	Activity 2.3.1: Train 90 governmental technical staff (15 per country covering 300 municipalities) on climate change adaptation, environmental and social management, and monitoring. Activity 2.3.2: Raise awareness amongst relevant local institutions on climate-resilient management of groundwater for agriculture and agribusiness. Activity 2.3.3: Review, harmonise and revise regulatory instruments regarding water rights and licensing, including borehole drilling. Activity 2.3.4: Undertake stakeholder analyses to identify needs and priorities for water-related adaptation in the agriculture sector. Activity 2.3.5: Support transboundary agreements on and validation of joint monitoring practices for the harmonised data collection on water and climate parameters. Activity 2.3.6: Conduct an institutional needs assessment for the ~~fulfilling~~ fulfilment of mandates related to groundwater management. Activity 2.3.7: Train non-groundwater specialists at the municipality level on groundwater management. Activity 2.3.8: Appoint mentors to junior ~~employess~~ employees in departments across the water sector.	information and guidelines that support better catchment planning and sustainable use of groundwater	and South Africa	
Component 3: ~~Climate-resilient agricultural livelihoods and infrastructure in TBA areas~~ To pilot and demonstrate concrete climate change adaptation measures based on sustainable land and groundwater utilisation to diversify and strengthen the livelihoods of the most vulnerable population in local Resilience Hubs in the TBA	**Output 3.1**: ~~Implementation of the Limpopo Basin and Sand and Gravel Aquifer JSAPs supported~~ (10 Climate-smart ecosystem mitigation and resilience projects implemented from the Limpopo Basin~~,~~ and Sand and Gravel Aquifer JSAPs) Activity 3.1.1: ~~Plan and budget for the implementation of the actions and establishment of the infrastructure detailed in the JSAPs.~~ (TORs and procurement of consultants on land use, forestry, ecosystem and environmental planning to design and ecosystem protection plans for the 10 sites) Activity 3.1.2: Identify and consult with beneficiary communities to inform the implementation of identified JSAP actions. Activity 3.1.3: Procurement of works ~~Support the~~and implementation of the ~~priority~~agreed 10 Climate-smart ecosystem mitigation and resilience projects ~~climate change adaptation measures, actions and infrastructure identified in the JSAPs.~~ in consultation with the respective Member States' Agriculture, Forestry, Land and Environmental Management ~~a~~Authorities **Output 3.2**: ~~Infrastructure for the climate-resilient use of groundwater in the Ramotswa Aquifer area planned and constructed~~10 climate-smart water and food security pilot projects using groundwater and rainwater harvesting (MAR, Sand dams, etc) at the community level implemented in the Ramotswa and Tuli-Karoo TBA) Activity 3.2.1: Plan and procure consultants to design the 10 climate-smart water and food security schemes ~~adaptation infrastructure for groundwater use~~ in the Ramotswa and Tuli-Karoo Aquifer area — technical designs, social and environmental impact assessments, climate change analyses, institutional and legal arrangements, cost-benefits analyses. Activity 3.2.2: Procurement and ~~C~~construction of the 10 climate-smart water and food security pilot projects ~~the adaptation infrastructure for groundwater use~~ in the	**Outcome 3**: ~~Enhanced Water Use Efficiency and Climate Resilience of agriculture and agribusinesses in TBA areas~~ ~~L~~The ~~l~~Livelihoods of communities in demonstration sites improved and diversified, reducing vulnerability to the impacts of climate change	**All aquifers~~ / ~~countries**	~~$10.28 million~~ $8,034,500

	Ramotswa and Tuli-Karoo Transboundary Aquifers ~~area based on the results of Activity 3.2.1.~~ **Output 3.3**: Total of 10 000 households , 502% of whom will be women, child and elderly headed households, in Limpopo~~,~~, Ramotswa; Sand and Gravel; and Tuli Karoo TBAs, respectively, supported through implementation of Climate-smart livelihood enhancement and diversification pilot projects using groundwater, rainwater harvesting and renewable energy ~~Increased water use efficiency to support the climate resilience of agricultural livelihoods in the Thuli Karoo Aquifer area.~~ Activity 3.3.1: Consultants procured to develop climate vulnerability criteria and facilitate participatory identification of beneficiaries in the 4 TBAs ~~Identify agribusinesses and farms in the Thuli Karoo Aquifer area to support with WUE interventions for climate resilience.~~ **Activity 3.3.2**: Consultants-led participatory designs of sustainable climate-smart livelihood enhancement and diversification pilot projects for the beneficiaries ~~Install groundwater extraction and crop yield monitoring devices at the agribusinesses and farms identified under Activity 3.3.1.~~ **Activity 3.3.3**: Procurement and installation of the agreed sustainable climate-smart livelihood enhancement and diversification pilot projects for a total of 10 000 households in Limpopo; Ramotswa; Sand and Gravel; and Tuli Karoo TBAs respectively beneficiaries ~~Introduce practices in agribusinesses and farms to improve WUE and crop yields under climate change conditions.~~ **Activity 3.3.4**: Beneficiaries, Agriculture, Water, NGOs and other stakeholders and local, district, national and transboundary level trained in the sustainable operation and maintenance of the installed sustainable climate-smart livelihood enhancement and diversification pilot projects ~~Train farmers and agribusinesses on the use of WUE and climate-resilient agricultural practices.~~ **Activity 3.3.5**: Consultants –led Gender Assessment to collect gender disaggregated data and gendered needs and priorities to inform projects design			
Project Execution cost (5%) Total Project Cost				$6~~45 500~~13 000
Project Management Fee charged by the Implementing Entity (8%)				$12 ~~900~~867 ~~000~~500
				$1 0~~3~~29 0~~4~~00
Amount of Financing Requested				**$13 ~~932~~896 ~~0~~900**

Projected Calendar:

Milestones	Expected Dates
Start of Project Implementation	December 2023
Mid-term Review	June 2026
Project Closing	December 2028
Terminal Evaluation	February 2029

PART II: PROJECT JUSTIFICATION

A. Project Components

32.34.The project will bring about concrete adaptation actions in the form of a combination of ~~new~~ natural-based and constructed~~new~~ water infrastructure to build ~~transboundary and regional climate change resilienc~~resilience in transboundary and regional climate change.~~resilience.~~ The process has several necessary components to ensure the infrastructure is prioritised~~,~~ and the design is resilient and developed in a ~~way sustainable in the long term.~~sustainable long-term way.~~.~~ This is particularly important for a regional project ~~such as this~~, whereby adaptation actions are being implemented in shared water resources~~, which are~~ utilised by two or more countries, and the potential for unsustainable use, maladaptation or even conflict is real. The project components have been designed and adapted based on lessons learned and good practices. As outlined above, they comprise the following:

Component 1: Data, information and knowledge for transboundary groundwater management policy and decision making

Output 1.1: TDAs for the Limpopo Basin and Sand and Gravel Aquifers developed

33.35.TDAs develop ~~the~~ information and knowledge about current water resources and future climate impacts to enable scientific and evidence-based ~~decision~~ decision-making at the national policy level. It will include an analysis of existing environmental and social conditions, risks and drivers that may influence or generate limitations, impacts and any other ~~type of~~ constraints on the water's management, use, availability and quality. This is important to ensure that adaptation investment is focused on where it is most impactful.

36. The process of undertaking the TDAs will include determining the: i) status of the water resources and their uses in the system, currently and under future climate scenarios; and ii) baseline sustainable abstraction rate under future climate projections to sustain agricultural livelihoods in the study area. Outputs of this process will include information and data on aquifer type and properties, hydrological properties, groundwater and surface water flows and the interaction between them, levels of flows, water quality, recharge rates, impact of climate change, environmental and ecological properties and dependencies, land use, and socio-economic characteristics of the supported population and economies.

Output 1.2: Construct numerical groundwater models for the Ramotswa TBA, Tuli-Karoo Sub-basin, Limpopo Basin and Sand and Gravel Aquifer

37. Developing a groundwater model of an aquifer system enables the quantification of groundwater and evaluation of groundwater dynamics. This includes quantifying and evaluating groundwater inflow (recharge from rainfall and lateral inflow), groundwater flow through the aquifer and groundwater outflow (subsurface drainage, seepage, evapotranspiration and abstractions).

38. The steady-state groundwater model can be considered a first step in quantifying groundwater in the TBAs and will be essential in designing and implementing a basin-wide integrated monitoring network of water levels, abstractions and water quality with the engagement of stakeholders from both the public and private sectors and civil society. In the future, when such an integrated monitoring

network is set up and when monitoring data are periodically collected (to include telemetry), the data processed and interpreted, the steady-state groundwater model could be converted into a transient-state groundwater model for a more detailed evaluation of sustainable groundwater use of the Basin aquifer system and for optimising the monitoring network.

39. The construction of the groundwater models allows interrogation of various pumping scenarios, e.g. for simulating climate variability and change, increasing abstraction related to irrigated agriculture, upconing of salt water and so forth.

Output 1.~~2~~3: 48 monitoring boreholes established, and data on groundwater in SADC's transboundary aquifers collected and collated via the GMI's Groundwater Information Portal

~~34.~~40.Currently, groundwater monitoring in the region is variable, with some countries ~~maintaining~~ monitoring boreholes~~,~~ while others~~other~~ lack monitoring. This creates unbalanced monitoring data for a transboundary aquifer, where two or three countries may extract groundwater from the same source. In addition, where data exists, it is not currently being fed into a central database, modelling and software system that provides ~~real~~ real-time information on water need, usage and extraction patterns. Making investment decisions on where to focus climate change adaptation efforts best is difficult. Joint management of transboundary aquifers requires a solid understanding of them~~the~~ and their response to external pressures. ~~Sustainability~~ The sustainability of proposed interventions is heavily reliant on feedback from monitoring systems. Activities under Output 1.~~2~~3 will address this shortcoming by establishing 48 automatic monitoring boreholes (8 per target country, aligning with the location of existing boreholes) to collect data on groundwater quality and quantity which will be fed into regional information systems. The project will deploy automated loggers with water quality monitoring functions. The loggers will measure TDS/Electrical Conductivity~~,~~ to serve as an indicator for parts of the aquifers with deteriorating water quality, where ~~follow~~ follow-up of the ~~full~~ complete set of water quality parameters can be implemented. In groundwater applications, conductivity can be used to identify saline intrusion, while it can also be used to determine pollution events. ~~—~~The data will be inputted in ~~real~~ real-time into the GMI's Groundwater Information Portal. This regional data portal ~~that~~ collates and shares data sets from boreholes to assist with ~~decision~~ decision-making.

~~35.~~41.Activities under Output 1.~~3~~2 will address this shortcoming by establishing 48 automatic monitoring boreholes (8 per target country, aligning with the location of existing boreholes) to collect data on groundwater quality and quantity which will be fed into regional information systems.

Component 2: Joint Strategic Action Plans (JSAPs) for climate-responsive governance, management and use of TBA groundwater resources

Output 2.1: JSAPs developed for the Limpopo Basin and Sand and Gravel Aquifers

~~36.~~42.The SADC-GMI seeks to bring regional solutions to climate change adaptation – an approach that can be complex and must be undertaken with due focus on ~~strong~~ solid stakeholder engagement processes to develop mutually agreed and supported adaptation actions. A solution is ~~the development and implementation of~~developing and implementing JSAPs for the sustainable management of TBAs under climate change conditions. JSAP development is vital in formulating a regional adaptation approach ~~in~~ to shared water resources. Under this output, JSAPs — aligned with local, national and regional priorities — for the Limpopo Basin and Sand and Gravel Aquifers will be developed through a consultative process based on the results of the TDAs (Output 1.1).

~~37.~~43.Key stakeholders from each riparian Member State brought together and engaged in developing the JSAPs. To get inputs and buy-in from a wide range of stakeholders, including government (Ministries, departments, and institutions), academia, civil society, communities and the private sector (e.g., Ramotswa JSAP, 2019). Utilising the Ramotswa Joint SAP as a blueprint, the development of the TBA SAPs will involve the following:

- The use of multisectoral platforms, such as the national chapters of the Limpopo and Zambezi Basin Stakeholders Committees (BASCs), to facilitate the participation of stakeholders and all

levels of government at national, provincial and local levels. This will help to get buy-in from technical experts and stakeholders.

- ~~The use of Multi-Country Cooperation Mechanisms (MCCMs) that~~Multi-Country Cooperation Mechanisms (MCCMs) will be nested in the structures of the RBOs to facilitate dialogue and stakeholder consultation at the TBA level.

~~38.~~44. The ~~above-mentioned steps~~steps as mentioned above will help bring critical issues to the political level and instil a sense of ownership of the SAPs among the stakeholders. The general practice is that documents such as JSAPs are approved and endorsed by ministers responsible for water in the riparian states. This goes a long way to solicit and maintain political commitment at the highest levels. ~~-~~The participation of government ministries will help align the SAPs with government programmes and priorities. This will help facilitate the channelling~~channeling~~ of resources by governments towards implementing the SAPs. Furthermore, the SAPs will also be aligned to Basin programmes in the Limpopo and Zambezi Basins.

~~39.~~45. The JSAPs will identify priority actions (using SWOT analyses based on the results of TDAs) to sustainably utilise the aquifers for domestic, agricultural, commercial and environmental (payment for ecosystem services) purposes. Actions that will deliver the ~~greatest~~ most significant climate resilience, water and food security and economic development impacts will be selected. The actions and ~~their implementation plans (including governance and institutional arrangements) will be developed and agreed upon jointly by the two or three countries who share~~implementation plans (including governance and institutional arrangements) will be developed and agreed upon jointly by the two or three countries sharing the resource. Political support will also be sought at the highest level through RBOs and WRTC to support the sustainable implementation of the JSAPs.

46. The project will integrate water resources management via the ~~TDA (Output 1.1) and JSAP (Outputs 2.1 and 2.2) development process~~.development process of the TDA and groundwater numerical modelling (Output 1.1) and JSAP (Outputs 2.1 and 2.2).~~-~~ In RBOs, where no previous integration of groundwater into the TDAs and SAPs has occurred, specific groundwater-related TDAs and SAPs are developed. The basis for the SAPs is the basin-wide SAPs. For example, for the STAS SAP, the point of departure was the Strategic Action Programme for the Orange-Senqu River Basin, guided by the overall objective: "Orange–Senqu basin states collectively reduce water pollution, control catchment degradation and mitigate the effects of environmental degradation". At a workshop attended by representatives of the Member States of the STAS and endorsed during national level dialogues, the following subsidiarity sustainability goal was formulated: "Improved groundwater governance in the STAS for a safe water and water secure future". In line with IWRM principles, the following strategic objectives have been identified through the consultative process: (i) Limit the decline in groundwater levels and reduction in storage to provide for equitable use of groundwater resources, (ii) maintain current groundwater quality by limiting anthropogenic and geogenic concentrations, (iii) strengthen source water protection and resilience of water supplies~~;~~., and (iv) develop and strengthen appropriate groundwater governance institutions resulting in capacitated local participative groundwater resource management~~.~~.

~~40.~~47. Resilience requires consideration of conjunctive use of surface and groundwater. Conjunctive management refers to the combined use of groundwater, surface water and other water sources to prevent irreversible impacts (quantity and quality) on either of the resources. The benefits of coordinated management of the water sources should exceed the benefits obtained through their separate management. Hydrogeological considerations are incorporated in the Buzi, Pungwe, Save (BUPUSA) River Basin TDA and SAP process. The objectives include: (i) characterise the BUPUSA hydrogeology and identify hotspots and groundwater connections to terrestrial ecosystems; (ii) contribute hydrogeological information and inputs to the Pungwe Basin comprehensive environmental-flows assessment; (iii) give technical inputs into the process of prioritising transboundary issues for consideration in the BUPUSA TDA; (iv) contribute hydrogeological inputs to the process of defining strategic interventions for the BUPUSA JSAP; and (v) strengthen the BUPUSA Joint Water Commission (JWC) capacity for groundwater management. A focus is on understanding the mechanisms for

groundwater discharge into rivers. This avoids 'double-counting' of an area's available surface water and groundwater resources, especially if both water cycle components are developed and managed separately.

Output 2.2: Ramotswa JSAP updated to support climate-resilient agriculture and agribusiness

41.48. Expanding Research and Knowledge on water needs and priorities for agribusiness in Ramotswa has recently been finalised, and a~~greed a comprehensive list of actions to sustainably develop the shared aquifer for resilient water supply.~~ comprehensive list of actions to sustainably develop the shared aquifer for resilient water supply has been agreed.~~.~~ The proposed new programme will focus on water use for agriculture, a key factor in food security and resilient livelihoods in Southern Africa. As such, this project component focuses on bringing agribusiness into the conversation to explore concrete adaptation actions together in a win-win for both the aquifer development, the agribusiness and, importantly, their outgrowers and local communities. It will hone the list of priority actions to those with an apparent~~a~~ demand, institutional owner, and market and guaranteed impacts.

42.49. Based on the existing Ramotswa JSAP, adaptation actions to enhance the resilience of agriculture and agribusiness will be prioritised. This will be achieved through a consultative process with commercial agribusinesses and out-grower networks regarding current climate and water stress, and co-development of water infrastructure, as well as seeking political support at the highest level through the RBOs structures (Forum of Ministers) and WRTC to sustain the further implementation of the JSAP's support of large agri-businesses in the aquifer area through addressing water-stress related climate impacts. In line with the current JSAP, water-related solutions to enhance the climate resilience of agriculture and agribusinesses will be prioritised.

43.50. Monitoring arrangements for the Ramotswa TBA to support sustainable management and development of the groundwater resource will be overseen by SADC-GMI, drawing from best practices and lessons from ~~the monitoring~~ monitoring other TBAs. To counteract the maladaptation of groundwater resources, SADC-GMI has programmed an approach to aquifer development and governance, including establishing primary and secondary groundwater monitoring systems. Installing primary monitoring systems is an upfront investment to determine baseline conditions. The primary monitoring systems establish baseline conditions of the aquifer systems. The baseline sites reflect ambient conditions and ~~are located in~~are in pristine areas. Secondary groundwater monitoring networks are located to serve specific purposes, such as monitoring water level decline around pumping well fields, monitoring the quality effects of irrigation schemes, and monitoring groundwater-surface water interactions. These networks are usually local, with configuration depending on the issues to be investigated and the aquifer condition. For example, we have designed monitoring systems for the Tuli-Karoo Sub-basin and are developing a numerical model being developed for the Eastern Kalahari Karoo Basin to inform groundwater monitoring. Through UNESCO support, the Stampriet Transboundary System (STAS) is developing a monitoring report that provides the status of the STAS. SADC-GMI has established groundwater committees in the RBOs to provide technical oversight and coordinate activities within the TBAs. All the riparian countries have or are establishing national focal groups (NFG) consisting of local stakeholders to oversee activities in priority aquifers. The low levels of current groundwater use and the monitoring interventions mean a low risk of maladaptation.

Output 2.3: Capacity built for improved governance of the Ramotswa Aquifer to support the sustainable implementation of the JSAP's water-related adaptation options for agriculture and agribusiness

44.51. This output ensures that the appropriate skills and capacities are present within institutions locally to continue to monitor and manage the water resources after the finalisation of this project to support the sustainable use of groundwater sources in the agriculture sector under future climate scenarios. It will focus on skills required to monitor and manage the aquifer water levels and quality, importantly focusing on the management of sustainable extraction rates, recharge, and how to bring future climate predictions into the operational decisions of local water management authorities. It will also give local institutions sufficient skills and experience to continue to develop adaptive infrastructure outside of this programme of work. The capacity development will include strong elements of cross-country sharing or

cross-country training~~,~~ to forge ~~stronger~~ more robust and cooperative arrangements between the two countries involved in the Ramotswa development.

~~45.~~52. Output 2.3 will build strong management and monitoring processes for the infrastructure, the water use and the aquifer~~,~~ to ensure the long-term viability of the water resources and infrastructure. Environmental analysis will provide integrated information on potential actions that may contribute to ensuring~~ensure~~ aquifer recharge~~,~~ and preventing landscape degradation, soil erosion and pollution. This output will lead to more efficient water use, enabling diminishing resources to go further, which, together with the climate-resilient infrastructure development above, will provide an adaptation response to the reduction in water resources and increased drought events being experienced in the region. The above will be achieved through: i) technical training for/capacitation of 90 governmental technical staff on climate change adaptation, environmental and social management, and monitoring; ii) awareness raising with relevant local institutions of climate-resilient management of groundwater for agriculture and agribusiness; iii) the review, harmonisation and revision of regulatory instruments regarding water rights and licensing, including borehole drilling; iv) stakeholder analyses to identify needs and priorities for water-related adaptation in the agriculture sector; v) agreeing on and establishing joint monitoring practices for the harmonised data collection on water and climate parameters; vi) undertaking an institutional needs assessment for the fulfilling of mandates related to groundwater management; vii) training non-groundwater specialists at the municipality level on groundwater management; and viii) appointing mentors to junior employees in departments across the water sector.

~~46.~~53. The GMI approach to aquifer development and governance in Southern Africa is a four-stage process, as shown in Figure 4. The process develops the baseline data and determines strategic priorities between the countries that share~~thatshare~~ the transboundary aquifer, enabling investment decisions and aquifer utilisation through infrastructure development and solutions for agriculture. The types of infrastructure include monitoring boreholes, production boreholes, storage tanks, distribution pipelines, irrigation, treatment facilities, domestic distribution and connections for potable supply. These enable the development of resilience hubs, communities with a secured climate-resilient water supply that can be used for domestic and agricultural purposes~~,~~ to build resilient livelihoods. A monitoring system is the final stage, which forms a feedback loop to inform future development and investments, and provides ~~real~~ real-time data to ensure sustainable extraction in the face of climate change and variability.

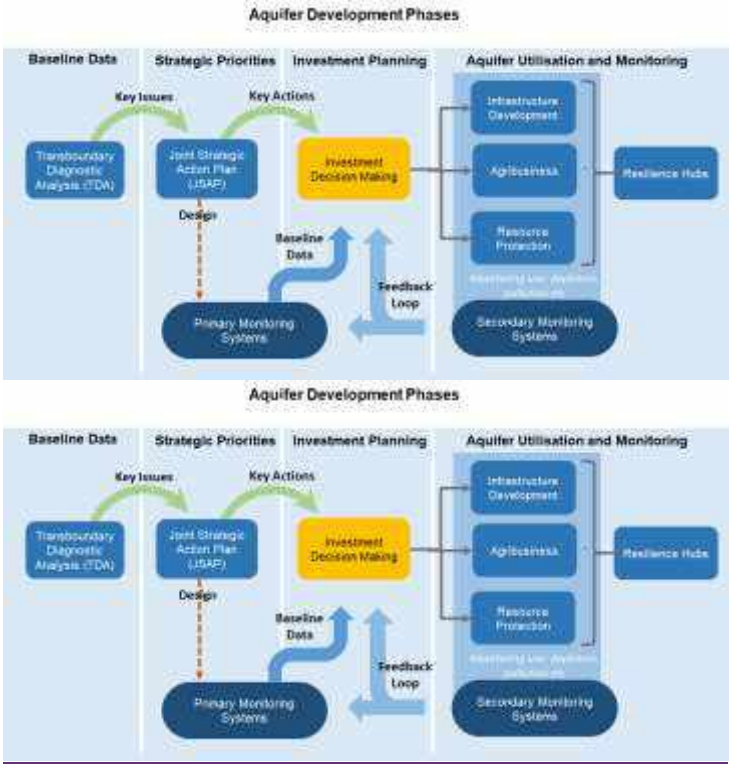


Figure 4. Aquifer Development and Governance process.

47.54.Beyond ~~the implementation of~~implementing the technical aspects described above, this output is intended to develop mutually agreed governance and cooperation frameworks in each TBAs through various key strategic steps. These include: i) the identification and implementation of strategic actions via JSAPs; ii) the establishment of Multi-Country Cooperation Mechanisms (MCCMs) for the joint governance of TBAs and implementation of JSAPs; iii) the establishment of groundwater- committees under the RBOs whom MCCMs will provide site-specific guidance to on the implementation of JSAP activities; iv) RBO task teams will provide technical support to MCCMs and groundwater committees; and v) RBO highest decision-making bodies (e.g., the ~~c~~Council~~council~~ of M~~m~~inisters or Limpopo River Commission) endorse- the JSAPs. Figure 5 is the diagrammatic description of the steps leading to the commonly agreed governance system in the Limpopo River Basin and the Zambezi River Basin. The process will be recommended to higher institutions of the Commission through the sub-committee responsible for groundwater in the respective river basin. In the ORASECOM the STAS MCCM was endorsed in under a year, i.e. from being recommended by the Groundwater Hydrology Committee to endorsement by the Forum of the Parties.

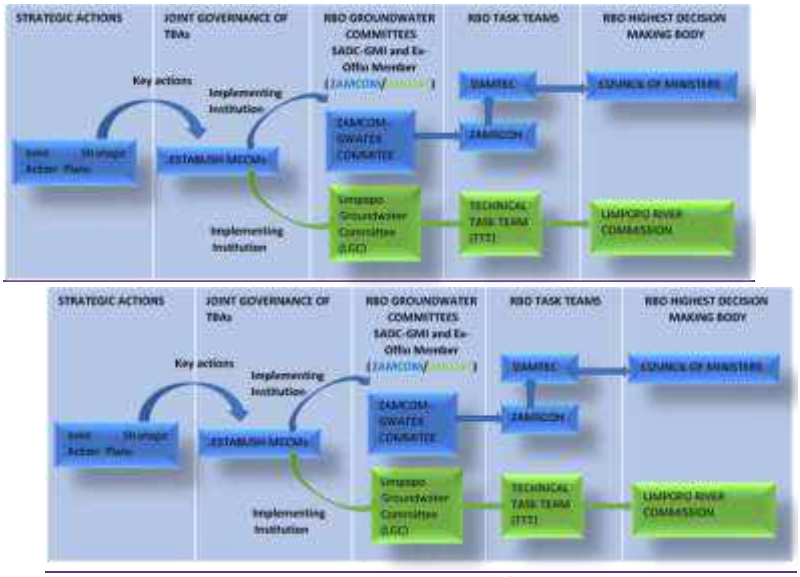


Figure 5. Steps leading to commonly agreed governance system. ([1]Zambezi Water Course Commission Technical Committee [2]ZAMTEC Sub-Committee on Hydrology)

From experience working in TBAs, ~~the development of~~developing TDAs and JSAPs serve as invaluable opportunities to ~~identify key stakeholders across sectors within the project areas holistically.~~identify key stakeholders across sectors within the project areas holistically.~~.~~ Equipped with the comprehensive register of key stakeholders, this component will facilitate the rolling out of the MCCM. The governance structure that was first piloted by the UNESCO-IHP in the Stampriet Transboundary Aquifer (TBA) and nested in the Orange-Senqu Watercourse Commission (ORASECOM) RBO. The riparian states of the Stampriet (Botswana, Namibia and South Africa) formed the MCCM in 2017 for the joint management of the Stampriet Transboundary Aquifer. This was the first arrangement of its nature on transboundary aquifers in Southern Africa[14]. The MCCM approach allows an IWRM approach to be used in managing TBAs.

~~48.~~55. SADC-GMI has already initiated measures to establish an MCCM within the Ramotswa TBA, which is intended to be nested within the Limpopo Watercourse Commission (LIMCOM) under the guidance of the LIMCOM Groundwater Committee that ~~was also established by SADC-GMI~~SADC-GMI also established in 2019. In the Zambezi River Commission (ZAMCOM),) the SADC-GMI has initiated work to establish a Groundwater Committee, which will nest the governance structures of the RBAs in the Zambezi River Basin.

56. The MCCM model nested within the respective River Basin commissions brings together stakeholders to guide the planning and development of the groundwater resources within the TBAs. Since the TBAs fall within RBOs, the MCCM's provide site-specific (TBA level) governance guidance to the respective Groundwater Committees under each RBO, including technical guidance and support on ~~the implementation of~~implementing activities emanating from the JSAPs. In addition, MCCMs will contribute towards policy formulation at the TBA level under the auspice of RBO groundwater management committees. During Funding Proposal development, the roles and responsibilities of MCCMs will be elaborated on through the development of framework Terms of Reference (ToR).

[14] https://groundwaterportal.net/stampriet-aquifer)

~~49.~~57. The Groundwater Committees are set up as sub-committee of the Hydrology Committee/technical committees of the River Basin Governance structures as guided by the SADC's revised protocol on shared water courses (2002) and the subsequent articles of the RBOs. It is through the Groundwater Committees that the RBOs will endorse the JSAP through the council of Ministers or the equivalent bodies. The Council of Ministers also endorses implementing priority actions from the SAPs that will be funded through the RBO budgets. The LIMCOM agreement, for instance, acknowledges the overarching role of the Revised Protocol on Shared Watercourses in the Southern African Development Community". It also acknowledges the Convention on the Law of the Non-Navigational Uses of International Watercourses and Chapter 18 of Agenda 21 of the United Nations Conference on Environment and Development. The LIMCOM agreement, through Article 1, defines the Limpopo watercourse as a system of surface and groundwater ~~'s~~ of the Limpopo, parts of which are situated in the territories of the Contracting Parties. The work proposed in this project aligns with the LIMCOM Integrated Water Resources Management (IWRM) plan developed in 2018. The said IWRM is the basis for the ongoing collaboration between SADC-GMI and LIMCOM to develop a Groundwater Strategy for the RBO, which will include all the elements of this project.

~~50.~~58. The Zambezi River Commission, through Article 5, has the objective to~~,~~ "promote equitable and reasonable utilization of the water resources of the Zambezi Water Course as well as the efficient management and sustainable development thereof "with specific functions articulated in Article 5(a) to 5(i). The ZAMCOM agreement defines the Zambezi Watercourse to mean the systems of surface and ground waters of the Zambezi constituting by ~~virtue of~~ their physical relationship a unitary whole flowing normally into a common terminus, the Indian Ocean. The definition of the Zambezi Watercourse gives ~~the~~ ZAMCOM a clear mandate of the transboundary aquifers within~~with~~ the b~~oundaries of the basin.~~asin's boundaries.~~,~~ Through Article 10, 2(d), the Technical Committee can establish ad hoc or standing working groups~~,~~ comprising representatives from the Member States as may be necessary for the implementation of the agreement. A groundwater Committee has been identified as one standing working group tasked to guide groundwater governance in the Zambezi River basin. The SADC-GMI is working with the ZAMCOM secretariat to establish the Groundwater committee in ZAMCOM within the framework of the ZAMCOM Strategic Plan (2018 – 2040). The ZAMCOM Strategic Plan takes a holistic focus on the IWRM framework as the basis for its vision. Hence this proposed project will contribute to realisation of this vision.

Component 3: ~~Climate-resilient agricultural livelihoods and infrastructure in TBA areas~~ Piloting and demonstrating concrete climate change adaptation measures based on sustainable land and groundwater utilisation to diversify and strengthen the livelihoods of the most vulnerable population in local Resilience Hubs in the TBA

The interventions under Component 3 will increase the climate resilience of vulnerable communities living in the target project wards. This will be achieved by increasing access to groundwater resources to support agricultural production and improve the sustainable management of these resources; implementing rainwater harvesting solutions; protecting catchments and wetlands; promoting conservation agriculture; improving water use efficiency through installation of water-saving irrigation techniques and cultivating a wide range of drought-resistant crops for income diversification. These interventions will reduce the impacts of periodic water shortages as a result of climate change on the livelihoods of vulnerable communities, while simultaneously contributing to environmental sustainability in the selected TBA.

Output 3.1: ~~Implementation of the Limpopo Basin and Sand and Gravel Aquifer JSAPs supported~~10 Climate-smart ecosystem Community-Based mitigation and resilience projects implemented from the Limpopo Basin and Sand and Gravel Aquifer JSAPs

~~51.~~59. Output 3.1 will see the implementation of the priority climate-smart mitigation and resilience initiatives to address the problems of ~~change adaptation measures, actions, and infrastructure identified (e.g., Managed Aquifer Recharge Schemes, AgWater Solutions) in the JSAPs~~ serious land

degradation and environmental destruction due to many factors including livestock overstocking, poor land husbandry practices, gully erosion worsened by cyclones, perennial veldfires, cutting down of trees for firewood, poor cultivation practices, etc which cause reduced provision of ecosystem goods and services (including water provisioning services) and generally reduce resilience of vulnerable communities to climate change. These factors affect groundwater recharge and utilisation. ~~. In the Limpopo Basin and Sand and Gravel Aquifer JSAPs. This will include planning and budgeting for the implementation of the actions and establishment of the infrastructure, as well as identifying and consulting target beneficiaries (direct beneficiaries – ~30,000 households; indirect beneficiaries – ~60,000 households).~~ High impact interventions under this sub-component will include organised community level landuse planning, land protection, wetlands, grazing, cropping, forestry, communal game ranching, etc,

Output 3.2: ~~Infrastructure for the climate-resilient use of groundwater in the Ramotswa Aquifer area planned and constructed~~10 climate-smart water and food security pilot projects using groundwater and rainwater harvesting (MAR, Sand dams, etc.) at the community level implemented in the Ramotswa and Tuli-Karoo TBA

~~52.~~ Based on the options prioritised in the Ramotswa and Tuli-Karoo JSAP, projects primarily focused on improving water supply to vulnerable communities during intense droughts as a result of climate change will be implemented by: i) drilling boreholes at strategic locations for improved access to groundwater resources; ii) establishing sand dams to abstract water from these resources; iii) installing rainwater harvesting schemes e.g weir dams; and iv) protecting freshwater resources to reduce pollution of these resources and ensure sustainable groundwater use by communities. ~~Infrastructure for the climate-resilient use of groundwater will be planned and constructed. This may include MAR, sand dams, boreholes, storage, transmission, and irrigation. The output will consist of full sub-project preparation, including technical designs, social and environmental impact assessments, climate change analyses, institutional and legal arrangements, and cost-benefit analysis for the construction of adaptation infrastructure, followed by construction. It is expected that 5-11010 medium medium-sized projects will be implemented. Projects will be selected in line with the portfolio budget of $1.5 million.~~ Under this sub-Component, 10 climate-smart water and food security pilot projects will support livestock and crop production

Output 3.3: A total of 10 000 households in Limpopo, Ramotswa; Sand and Gravel; and Tuli Karoo TBAs, respectively, supported through the implementation of Climate-smart livelihood enhancement and diversification pilot projects using groundwater, rainwater harvesting and renewable energy~~Increased water use efficiency to support the climate resilience of agricultural livelihoods in the Thuli Karoo Aquifer area~~

60. This sub-component seeks to simultaneously address the challenge of water security, food security and income security at household level because of their interdependency especially under the extreme climate scenarios. Addressing these aspects is expected to boost the households' asset base and subsequently enhance their adaptive capacity and increase the ability of the household to positively respond to climate change impacts, thus reducing overall vulnerability. 'Asset base' refers to the financial, physical, natural, social, political and human capitals necessary to prepare a system to best respond to a changing climate. The project aims to support 10 000 households in the selected TBAs.

61. Due to the erratic nature of rainfall and frequent droughts, the households' livelihood activities in the project areas are dominated by cattle farming and rain-fed cereal production. It is expected that the introduction of protected deep wells with large storage volumes, sand dams, water harvesting technologies and water saving technologies such as drip irrigation by the project will ensure improved water access and water efficiency. As a result of improved water supply, the communities will be able to diversify livelihoods options from cattle and cereal production to poultry, piggery, fishery, orchards and horticulture. The use of renewable energy to pump the groundwater is expected to enhance efficiency and resilience.

~~53. The total area under irrigation covered by the Tuli Karoo aquifer is 12,000 ha. The largest area under irrigation is in South Africa (6,900 ha), followed by Zimbabwe (2,900 ha) and then Botswana (2,000 ha). Total rainfed agricultural land is just over 84,000 ha. The largest area under rainfed~~

~~production is in Zimbabwe (31,670 ha), followed by Botswana (28,440 ha) and then South Africa (24,780 ha). Approximately 1% of the Tuli Karoo Aquifer Area is under irrigation, and just under 7% of the area is used for rainfed agriculture. Water consumption under irrigation was estimated at 133 million m^3/a based on 2017 evapotranspiration data.~~

~~54. Most smallholder farmers use inefficient surface irrigation methods (e.g., furrow and border systems), indicating a great potential to increase water use efficiency (WUE) by converting to drip systems and using soil and nutrient monitoring tools, underscoring the need for climate-resilient agricultural interventions which will rely on groundwater. The proposed programme is expected to directly reach at least 30% of the existing farmers with the WUE activities (8,000 HHs covering an estimated 10,000 ha) through the introduction of interventions promoting WUE under climate change conditions. The rainfed areas will be similar proportions for the land under production (30,000 ha). Sustainability and efficiency will be promoted using renewable energy, e.g. solar, taking into accountconsidering the cost and efficiency, ofon pumping and water distribution.~~

Project approach to avoiding maladaptation

62. Efforts to avoid maladaptation at a larger scale in the TBAs include diagnostic analysis and numerical modelling in component 1 to identify significant risks and responsible adaptation strategies throughout the implementation of Components 2 and 3. The adaptation strategies will include: (1) the broader adoption of blended grey–green–blue infrastructure, (2) implementing pumping regimes that preserve and protect aquifers, (3) joint management of surface water and groundwater, (4) mapping, conserving, maintaining or rehabilitating (groundwater-dependent) wetland ecosystems and (5) ensuring extensive cooperation among neighbouring States to manage rivers and aquifers affected by climate change. Joint data and knowledge-sharing arrangements and joint monitoring of basin conditions are prerequisites for successful transboundary cooperation in an era of climate change.

~~55.~~63. The secondary monitoring systems proposed under this project (Output 1.~~2~~3) will be carefully designed and installed to strategically generate real-time data on the current and future usage of the groundwater system and thus subsequently guard against 'maladaptation'. To counteract the maladaptation of groundwater resources, SADC-GMI has programmed an approach to aquifer development and governance, including establishing primary and secondary groundwater monitoring systems. Installing primary monitoring systems is an upfront investment to determine baseline conditions. The primary monitoring systems establish baseline conditions of the aquifer systems. The baseline sites reflect ambient conditions and are located in pristine areas. Secondary groundwater monitoring networks are located to serve specific purposes, such as monitoring water level decline around pumping well fields, monitoring the quality effects of irrigation schemes, and monitoring groundwater-surface water interactions. These networks are usually local, with configuration depending on the issues to be investigated and the aquifer condition. For example, monitoring systems have been designed for the Tuli-Karoo Sub-basin, and a numerical model for the Eastern Kalahari Karoo Basin is being developed to inform groundwater monitoring~~. Through UNESCO support, the Stampriet Transboundary System (STAS) is developing a monitoring report that provides the status of the STAS~~. SADC-GMI has established groundwater committees in the RBOs to provide technical oversight and coordinate activities within the TBAs. All the riparian countries have or are establishing national focal groups (NFG) consisting of local stakeholders to oversee activities in priority aquifers. The low levels of current groundwater use, the type of aquifer systems and the monitoring interventions mean a low risk of maladaptation. In addition, climate-resilient agricultural practices (Component 3) will be promoted, and productive landscape management will include soil and water conservation techniques to improve the infiltration of water, which will contribute to avoiding maladaptation. In this regard, maladaptation will be avoided by ensuring that monitoring systems contribute to more effective planning and timely identification of 'red signs' of potential maladaptation so that appropriate corrective measures are taken in a timely fashion. A focus on climate-resilient livelihood opportunities to broaden the communities' socioeconomic base will also contribute to the aversion to maladaptation.

B. Innovation

56.64.The very nature of the project and its goal is innovative. The traditional approach for the use of aquifers has been for each country to exploit the resource on a national scale with little regard for the effect on water resources across the border. The ,inatural-nbased infrastructure that will be implemented is proven and well-well-known, h. Howeverhowever, the joint utilisation of transboundary aquifers to support livelihoods and promote climate resilience, and to establish a joint monitoring network between countries is innovative and new to Southern Africa and indee, promote climate resilience, and establish a joint monitoring network between countries is innovative and new to Southern Africa andindeed Sub-Saharan Africa, where groundwater, in general, is under-utilized and under-developed.

57.65.The project goes beyond research and action research, to directly link research to implementation, development impact and climate resilience on the ground. This transcends the common issue whereby research outputs and reports are generated, and the information is not get acted upon. By linking research to direct implementation, adaptation investment is targeted according to robust evidence, and that research investment is targeted to where the results will be acted upon in the same programme.

58.66.The SADC region is generally a data-data-scarce region with regard to scientific data on groundwater and climate change impacts. Data scarcity is more pronounced in transboundary aquifers. The TDAs in the Sand and Gravel Aquifer and the Limpopo Basin Aquifer will develop and test big data methodologies to help provide an innovative solution to this common problem. This will draw from a pilot project on the applying big data approaches in Transboundary Aquifers, implemented by Water Research Commission (WRC), US Geological Survey (USGS) and the IBM Research Africa Lab in South Africa with funding from USAid-USAID and others.

Approach to climate change and building adaptation resilience

59.67.Through improved monitoring systems and data on water flows, decision-decision-makers will be better able to make informed adaptation investment decisions. They will be able to target funds where most needed, where water resources are most vulnerable, or climate affected, to increase water use efficiencies, climate-climate-proof infrastructure and build resilience.

60.68.The infrastructure prioritised for development will be prepared in line with the climate resilience guidelines of CRIDF, which is aare partners in this proposal. CRIDF has developed a range of tools to guide the development of infrastructure that both builds resilience to climate change and alsouilds resilience to climate change and the infrastructure suitable for future climatic scenarios.

61.69.In particular, the Risk and Vulnerability Assessment Tool (RVAT) evaluates the climate risk and vulnerability of communities, and water infrastructure projects. The tool assesses how current and future climate hazards (such as temperature, rainfall, droughts and floods) impact the broader community, as well as and existing and potential water infrastructure projects in communities. Based on the overalloveral risk and vulnerability, the tool explores possible interventions that will improve climate resilience, prioritizing best practices and sustainable technologies, such as using renewable energy, e.g. solar, for water pumping and distribution. It utilises the updated Intergovernmental Panel on Climate Change (IPCC) methodology and the Vulnerability Sourcebook by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ).

62.70.To ensure equitable, fair and climate-climate-resilient access for smallholders, the project will complete the development of evaluative frameworks for climate change adaptation and resilience at local to national conditions in Zimbabwe, Zambia, Mozambique, Malawi, Botswana and South Africa. The results of the evaluation will inform the design and implementation of the project.evaluation results will inform the project's design and implementation. The framework will also enable the assessment of how the project interventions will improve the climate resilience of smallholder farmers.

~~63.~~71.A consultative process of identifying smallholder farmers through producer/growers associations, government departments/agencies and other stakeholders will be implemented to ensure equitable and fair access to ~~climate~~ climate-resilient interventions by smallholders.

C. Project economic, social and environmental benefits and compliance with the Environmental and Social Policy of the Adaptation Fund.

Economic, Social and Environmental Benefits

72. Further to responding to the need for access to water and a sound and sustainable management of this vital resource, the project aligns with international, regional and national legislation. It is also aligned with policies on agriculture, water and natural resources management, climate change adaptation, land tenure, public procurement, decentralization, farmers' organizations and unions, employment, women's rights, and, promoting integrated and intersectoral sustainability.

73. **Economic benefits** – The project will increase agricultural productivity through increased access to water and climate resilient agricultural practices linked to output 2.2 and 2.3. The enhanced productivity of agribusinesses and related economic benefits, with the potential to create sustainable jobs and increased tax contribution to national economies. Through output 3.2 there is potential for enhanced food security for local communities resulting from improved productivity and diversification on farms. In the long-term, the project will result in increased and more secure agricultural livelihoods through improved productivity, reduced climate risk to agri-businesses, under changing climate conditions.

74. **Social benefits –** The project will be inclusive guided by IFAD's mainstreaming agenda for gender and youth as well as IFAD's targeting policy, the project will aim to reach at least 50% women among the beneficiaries and 25% youth. Social inclusion will be part of the targeting strategy for the project, through inclusion of vulnerable and marginalised groups. The selection criteria will be discussed with communities under component 3 mainly considering education, type of housing, average area of land owned and number of live stocked owned. The project will contribute to making visible the role of women, advance gender equality, and to incorporate gender-sensitive actions and climate smart technologies. A detailed gender strategy will be developed at full proposal stage to encompass community consultations with all stakeholders to make informed specific project designs that addresses each of the groups' needs and priorities. The Gender Action Learning System (GALS) approach will be used to find innovative, gender equitable solutions for the communities. Focus will also be on strengthening capacities of local stakeholders to empower them to implement adaptation actions. According to output, 3.3 the project will collect gender disaggregated data.

~~64.~~75. **Environmental benefits** – Joint Strategic Action Plans (SAPs) under output 2.1 will enable sustainable use, management and protection of shared groundwater resources and avoid over abstraction of water resources. A focus on the land use, forestry, and ecosystem protection based protection for the proposed sites indicated on output 3.1 will result in enhanced natural resources and environmental management capacity. The project will promote integrated water resources and landscape management, ensuring integrity and availability of ecosystem services. The landscape management activities, including land protection, wetlands, grazing, cropping, forestry, will, reduce the loss and degradation of soil, prevent soil, and water pollution. The promotion of renewable energy will reduce greenhouse gas emissions important for combating climate change

~~Enhanced productivity of agribusinesses and related economic benefits, with the potential to create sustainable jobs and increased tax contribution to national economies.~~

~~Guided by IFAD's mainstreaming agenda for gender and youth as well as IFAD's targeting policy, the project will aim to reach at least 50% women among the beneficiaries and 25% youth. Social inclusion, particularly of inclusion of vulnerable and marginalised groups, will be part of the targeting strategy for the project.~~

- Strengthened capacities of local stakeholders to empower them to implement adaptation actions.
- Enhanced natural resources and environmental management capacity.Promote integrated water resources and landscape management, ensuring integrity and availability of ecosystem services.

65.76. This programme will bring about significant socio-economic and environmental benefits, to several stakeholders. These include:

- Climate resilient water supply for smallholder farmers, including youth, women and other most vulnerable communities.
- Promote integrated water resources and landscape management, ensuring integrity and availability of ecosystem services.
- Reduce the loss and degradation of soil and prevent soil and water pollution.
- Contribute to making visible the role of women, advance gender equality, and to incorporate gender-sensitive actions.
- Increased youth participation in agricultural productivity and natural resources management;
- Increased and more secure agricultural livelihoods through improved productivity.
- Enhanced food security for local communities resulting from improved productivity and diversification on farms.
- Reduced climate risk to agri-businesses, under changing climate conditions.
- Enhanced productivity of agribusinesses and related economic benefits, with the potential to create sustainable jobs and increased tax contribution to national economies.
- Enhanced natural resources and environmental management capacity.
- Increased awareness of interlinkages between the environment, climate change, agriculture and human wellbeing.
- Strengthened capacities of local stakeholders to empower them to implement adaptation actions.

66.1. Guided by IFAD's mainstreaming agenda for gender and youth as well as IFAD's targeting policy, the project will aim to reach at least 50% women among the beneficiaries and 25% youth. Social inclusion, particularly of inclusion of vulnerable and marginalised groups, will be part of the targeting strategy for the project.

67.77. The economic, social and environmental benefits will be further quantified at design stage and included in Environmental and Social Management Framework (ESMF) that will guide the project implementation. The ESMF will be developed by applying IFAD's Social, Environmental and Climate Assessment Procedures (SECAP) and national regulations. The ESMF will detail the measures to avoid and minimize any adverse impact of the project activities on the environment and social structures. The ESMF will be developed to ensure adherence to the Environmental and Social Policy of the Adaptation Fund. The implementing environmental authorities will ensure compliance with applicable standards and regulations in collaboration with the SADC-GMI team. The Environmental and Social Management Frameworks of the SADC-GMI will guide the management of the environmental and social impacts of infrastructure projects such as Managed Aquifer Recharge sites, agricultural plots, borehole drilling sites etc.

Preliminary Gender Analysis

78. A desk based gender analysis has been completed in order to collect gender data and understand the national and regional legal and policy framework regarding gender integration in the region and in the six member states being targeted by this intervention and the gender differences between girls and boys, men and women in the different member states. The analysis also looked into the river basin organisations' gender policy frameworks i.e ZAMCOM and LIMCOM Gender mainstreaming strategies. The results of the analysis have informed interventions proposed in component 3 of this proposal. The component seeks "To pilot and demonstrate concrete climate change adaptation measures based on sustainable land and groundwater utilisation to diversify and strengthen the livelihoods of the most vulnerable population in local Resilience Hubs in the TBA" and this is in fulfilment of Programme Objective 4 of this concept proposal which seeks to "To pilot and demonstrate concrete

climate change adaptation measures based on sustainable land and groundwater utilisation to diversify and strengthen the livelihoods of the TBA's most vulnerable population in local Resilience Hubs".

~~68.~~79. The components are responsive to the gender differences and operating environment in the region and its outputs seek to promote gender equality and doing good and will target to benefit 50% women and girls in the proposed countries. The percentage is informed by the statistical analysis of regional data which shows that on average the population of women is around 51% and that the majority i.e. over 60% are employed in the agriculture sector or rely on rain-fed agriculture as their source of livelihood. Piloting climate smart and sustainable agriculture projects through groundwater utilisation enhances and promotes the resilience of the marginalised river basin communities. The domains for analysis used were access, power and decision making, time use, participation, leadership and empowerment, legal rights and status as well as practices and knowledge levels. Further analysis is provided in an Annexure to this Concept Note

D. Cost Effectiveness

80. In Southern Africa knowledge on groundwater is poor across the region due to lack of technical and institutional capacity. This has led to very little understanding of groundwater resources which support the primary water needs and livelihoods of 70% of the region's population. A portion of the Project Funds under Components 1 and 2 (US$4.22~~$2.62~~million) will be used to address gaps in data, information and knowledge required for policy formulation and sound decision-making required for sustainable groundwater management. Stakeholder involvement in the development of TDAs and JSAPs for the TBAs will help to put in place the buy-in required to sustainably capacitate institutions beyond the project implementation phase.

81. Because transboundary aquifers span over political boundaries, some of their critical components such as recharge and discharge zones can sit in different countries. According to the International Shared Aquifer Resources Management (ISARM), this has made countries realise the benefits of cooperation hence the increase in joint management of transboundary groundwater resources. In their paper published in 2019, Kim and Kim demonstrate that the long-term benefits of groundwater monitoring outweigh the costs by a factor of 2.91. The transboundary groundwater monitoring exercise proposed under Component 1 of the project will generate data and information required for policy making and sound decision making. The participation of institutions in member states and their rendering of support through in-kind contributions such as staff secondment and availing of equipment (e.g. vehicles) will go a long way to inculcate a sense of ownership. This will create the critical momentum required to continue the monitoring exercise after the project concludes. The use of existing platforms such as the regional SADC Groundwater Information Portal (GIP) for data sharing will also significantly make the project sustainable beyond the implementation period.

82. Under Components 2, the project will train 90 technical staff members (15 from each country) and non-technical staff, hence building the capacity of 300 municipalities and other institutions in climate change adaptation, environmental and social management, and monitoring. This will go a long way to address the capacity gaps in institutions and help them establish robust climate resilience mechanisms.

83. About US$~~10.28~~8,034 million of the Project Funds will be allocated to Component 3 for the implementation of concrete actions for climate change adaptation measures that will put in place sustainable groundwater development, ecosystems and improved agricultural productivity. These interventions, that are expected to benefit 10,000 households in the TBAs, will be ringfenced around ecosystems and climate smart livelihoods. Through this component of the project 10 climate smart and ecosystem mitigation and resilience pilot projects will be implemented across the transboundary aquifers. These pilot projects will address catchment degradation, lowering of the groundwater table, the degradation of groundwater dependent ecosystems and the loss of tress and vegetation. The benefits accrued from the pilot projects include ecosystem restoration and the creation of goods and services that will be utilised by communities. The pilot projects will also help diversify livelihoods and leverage funding for ecosystem-based interventions such as apiary and agroforestry.

84. Through component 3 the project will also establish climate-smart water and food security pilot projects that will use groundwater and rainwater harvesting. The pilot projects will put in place climate smart infrastructure and technology such as sand dams, infield water conservation, water efficient irrigation (drip irrigation) and renewable energy (solar). To instil a sense of ownership and help sustain the pilot projects, the implementation of these interventions will be managed through village coordinating structures that include village authorities (traditional authorities and local government structures), government extension staff, NGOs and the special socioeconomic groups (e.g., women, youth and the disabled). The involvement of NGOs will help leverage resources that will go a long way to sustain the projects.

85. The project will build on collaborative work in the transboundary aquifers carried out by SADC-GMI, the riparian countries and the River Basin Organisations (the Zambezi Watercourse Commission and the Limpopo Watercourse Commission). It will also feed into planned interventions that will be done in the TBAs, e.g. the Global Environment Facility funded project on "Integrated Transboundary River Basin Management for Sustainable Development of The Limpopo River Basin" and the Programme for Integrated Development and Adaptation to Climate Change in the Zambezi Basin (PIDACC Zambezi). This will make sure that the project gets the momentum necessary to take it beyond the requested funding period.

A comparison of proposed project activities and alternative interventions

Project Activities	Alternatives	Remarks	Cost Implications
Development of TDAs and JSAPs for the TBAs building on collaborative work done by SADC-GMI, the RBOs and the riparian countries.	Developing the TDAs and JSAPs for the TBAs without using previously done work.	The development of the TDAs and JSAPs requires background information that takes a great deal of time and resources to collect. Hence the alternative is time consuming and expensive.	Building on previous work to develop the TDAS and JSAPs saves both time and financial resources.
Developing numerical models for the TBAs	Field experiments	Unlike models, field experiments are expensive to run and take a great deal of time and financial resources.	Numerical models are a quick way to quickly obtain needed information at a significantly reduced cost.
Groundwater monitoring using a combination new and existing boreholes	Groundwater monitoring using new boreholes only. Groundwater monitoring using old boreholes only.	The drilling of new monitoring boreholes will only be determined through network design.	A great deal of saving will be done by using existing boreholes.
Capacity building of institutions and training of communities	Outsourcing services	Training local people will impart in them a sense of project ownership. This will help build the momentum required for long-term sustainability of project interventions. Unlike external service providers, trained community members will go on to share knowledge and information.	Training community members costs significantly less compared to bringing in consultants. Furthermore, the benefits of training locals that accrue over time significantly outweigh bringing in consultants.
Borehole drilling	Dam construction	In comparison to borehole drilling, dam construction is significantly expensive. Dam construction is also limited by the occurrence of favorable topography.	Borehole drilling costs about US10,000 compared the construction of a small dam that requires US$0.5 million – US$1 million.
Putting in place power and water efficient Irrigation Schemes (solar powered drip Irrigation)	Sprinkler irrigation, flood irrigation and center pivots	The alternative methods are less water efficient. According to FAO sprinkler irrigation is 75% efficient, flood irrigation is 60% efficient. Centre pivots consume a significant amount of energy and have high operation and maintenance costs.	Drip irrigation has an efficiency rate of over 90%. Because of the high temperatures in the project areas, it is the best alternative. This is despite the fact that it has higher capital costs compared to the other of irrigation.
Integrated farming (including agroforestry and apiary)	Traditional farming	Integrated farming is a closed loop system that recycles nutrients and makes efficient use of power. It minimises the loss of nutrients and	The cost of production is significantly less because of the minimal input of fertilizer and pesticides. It produces better quality crops and products that fetch more on the market.

		energy. More crops are grown and higher yields can be obtained compared to traditional farming systems	

Project Activities	**Alternatives**	**Remarks**	**Cost Implications**
Numerical modelling of the TBAs	Field experiments	Numerical models provide information on groundwater that may not be available or can only be obtained through extensive field experiments	Field experiments are time consuming and expensive. Numerical modelling can be used to quickly obtain needed information at a reduced cost.
Development of TDAs and JSAPs for the TBAs building on work that has already been by SADC-GMI, RBOs and riparian states	Development of the TBAs and JSAPs without building on previously done work	The process of developing of TBAs and JSAPs	Building on work already done saves both time and money.
Training communities and capacity building of institutions	Outsourcing services	Having local stakeholders trained will give them a sense of ownership. This is critical for the long-term sustainability of the project. Trained community members will also pass on knowledge unlike external service providers.	This is a cheaper option with far reaching benefits.
Borehole drilling	Dam construction	In addition to being expensive, dam construction also relies on the occurrence of favourable topography	Borehole drilling costs on average US$10,000 and is a better option compared to small dams that cost between US$0.5 million – US$1million
Adopting climate and energy smart technologies such as drip irrigation and solar power.	Overhead irrigation, centre pivots and flood irrigation	The alternative methods are not water efficient. According to the FAO overhead irrigation has an efficiency of 60%. Flood or surface irrigation as an efficiency of 75% and leads to the accumulation of salts in soil over time. Both methods are also less desirable because of the high temperatures experienced in the project areas. Drip irrigation has an efficiency rate of over 90%.	For small scale interventions, the capital costs for drip irrigation systems per hectare are about 20% higher than for springer and flood irrigation. The energy costs are less because of significantly less pumping time.
Integrated farming	Traditional farming	Integrated farming is a closed loop system that is energy and nutrient efficient. Unlike traditional farming, an integrated farming system grows more crops and produces higher yields.	The cost of production for integrated farming are lower because it requires less fertilizers and chemicals to grow crops. It also produces good quality crops that fetch more on the market (organic farming)

E. Consistency with national or sub-national sustainable development strategies

~~69.~~86. The implementation of the project will be nested in the programmes and activities of the SADC riparian states and relevant RBOs, ensuring that it will be an integrated part of water resources management in TBAs. This includes alignments with water resource management strategies and plans such as LIMCOM's IWRM Strategy and Strategic Action Plan and the Zambezi Strategic Action Plan (ZSP).

Alignment with Regional and National Development Strategies

~~70.~~87. SADC Water Division provides the regional framework for water, ongoing guidance to support the various Member States in collectively supporting and attaining the objectives within this regional framework. This regional framework consists of the SADC Regional Water Policy (2005), SADC Regional Water Strategy (2006), SADC Regional Strategic Action Plan (through various phases of development) and SADC Revised Protocol on the Shared Watercourses (2000). The proposed work makes a significant contribution to the protocol, by advocating for joint planning, development and management of the transboundary aquifers. The pertinent policy documents are summarized below.

- The SADC Regional Water Strategy (2006) describes the strategies for achieving development and poverty reduction within SADC through integrated planning, development and management of water (SADC, 2006). It seeks to address the historical practice where surface water and groundwater resources are compartmentalized instead of viewing and managing them as an interlinked hydrological unit under the rubric of water and environment. Two key strategies directly relate to groundwater, with both focusing on ensuring livelihoods and food security:
  - The first aims to promote construction of multi-purpose storage facilities that will benefit irrigation and ground water recharge to enhance food security'. This recognises the importance of groundwater resources to rural communities that are not supported by reticulated water supply systems.
  - The second is to 'attain Regional Food Security through sustainable irrigated agriculture, rain-fed agriculture, aquaculture and livestock production, through optimal use of both surface and ground water with the ultimate goal of poverty reduction'.
- The Regional Strategic Action Plan (Phase Four) (RSAPIV) (2016 -2020) has the key objective to unlock the potential for water (and related resources) to play its role as an engine and catalyst for socio-economic development. To do this, the RSAPIV recognises the importance of ecological infrastructure and built infrastructure in providing the basis for water supply and sanitation, energy security, industrial development, food security and protection from water-related disasters. Groundwater resources provide support in maintaining ecological infrastructure and are also a key source of supply. RSAPIV recognizes the need to modernize and harmonize legal, policy and regulatory frameworks to address gaps in institutional groundwater management tools at national and transboundary levels. Key to this is the advancing transboundary and national groundwater knowledge through various initiatives and studies.
- The overarching legal framework governing transboundary water in SADC is the Revised Protocol on Shared Watercourses in the Southern African Development Community (2000). The scope of the Protocol includes shared "watercourses," defined as seas, lakes or aquifers.
- Recently the SADC-GMI completed a Regional Framework for Groundwater Data Collection and Management, which was presented to the Water Resources Technical Committee of the SADC. The proposed work will significantly contribute to regional groundwater data collection and management.

~~71.~~88. The project will have a footprint in Botswana, Malawi, Mozambique, South Africa, Zambia and Zimbabwe. The national frameworks to which the proposed work will contribute are summarised below.

Botswana:

~~72.~~89. The Botswana Draft Climate Change Response Policy 2017 notes that the country's development and growth potential depends water availability for domestic and economic purposes. Botswana National Adaptation Strategy 2020 acknowledges that the country is facing the negative impacts of climate change as evidenced by endemic droughts, heavy rainfall, heat waves, and severe thunderstorms. It also recognises that agriculture, water, health and biodiversity are most vulnerable. The Botswana's Third National Communication to UNFCCC (2019) recognizes that whilst surface water resources are highly exposed to climate change through an increase in temperature and reduced rainfall, groundwater is sensitive to climate change through reduced recharge and increased abstraction to meet the water demands. Therefore, climate change could transfer pressure to groundwater through the scarcity of surface water resources.

~~73.~~90. The Government of Botswana also recognizes that food production is closely linked to water availability and will face increased stress in districts where water stress is exacerbated. In the Climate Change Response Policy, the Government has committed to adopting water management strategies that would achieve sustainable water conservation and use efficiency, and among them are:

- Utilization of shared water courses for the benefit of Batswana.
- Integrating climate change response measures across all economic sectors in the water planning processes.
- Consideration of defining potential water aquifers and adopting appropriate protection measures for water security and sustainability.
- Promote rainwater harvesting, re-use and recycling for domestic, agricultural, industrial and commercial purposes.
- Employing accounting and valuation tools to support water management decision systems.

~~74.~~91. The key strategic pathways for the Government of Botswana's National Strategy for Poverty Reduction (2003) are aligned to the ~~objectives of the proposed project~~proposed project's objectives: 1. The promotion of broad-based growth focused on sectors that benefit the poor (creating and expanding employment opportunities and sustainable livelihoods); 2. The enhancement of human capabilities of the poor (enhancing access to basic quality education, health and nutrition for the poor); 3. The promotion of cost-effective pro-poor social safety nets (improved targeting and coverage, and level of benefits for the poor); 4. An enhanced effective response to the HIV/AIDS epidemic (reducing the aggravating effect of the disease on employment and productivity, disease burden and health costs, and vulnerability to poverty), and; 5. The strengthening of institutions for the poor to affect their participation in the growth processes, and enables their access to social services and public safety nets.

Malawi

~~75.~~92. The Second National Communication (SNC) of Malawi to the Conference of the Parties (COP) of the United Nation's Framework Convention on Climate Change (UNFCCC) 2011 states that Malawi derives the bulk of its revenues from the agriculture sector, whose viability depends on the availability of water (adequate and reliable rainfall). As such, the country's economy, prosperity and the well-being of its people are highly vulnerable to climate change and variability. Malawi's water policy (National Water Policy (2005)) aims to protect groundwater by preventing pollution and overuse. It promoted Integrated Water Resources Management (IWRM) and consideration of cross cutting issues such as climate change. The Water Resources Act of 2013, Water Resources Regulations (2018) and Environmental Management Act (2017) explicitly address the use, management, and protection of groundwater and provides the necessary tools for the state to regulate, manage, control, protect and develop groundwater resources in conjunction with surface water resources in Malawi. It specifies the need for long-term plans to ensure the sustainable use of groundwater, including drought management plans and cross-sectoral coordination. The Malawi National Adaptation Framework 2020 notes that every year, Malawi loses an average of 1.7% of its GDP as a result of climate change-related disasters, mainly floods and drought. The successful implementation of the Malawi Growth and Development Strategy (MGDS) also hinges on pursuing key priority areas of agriculture and food security, irrigation

and water development, among others. Malawi's Nationally Determined Contributions (NDC) include key and integrated, actions addressing the sustainable use of water, such as upscaling afforestation, reforestation and forest conservation and protection of catchments, dissemination of climate resilient agronomic practices (e.g.: on-farm water conservation technologies, improved land and water use practices, capacity building integrated water resources management).

South Africa

~~76.~~93. The National Climate Change Adaptation Strategy (NCCAS 2019) provides a common vision of climate change adaptation and climate resilience for the country. It outlines priority areas for achieving this vision. The country has identified a number of adaptation options in the agriculture sector, including those related to water availability and management; to hazards; the natural resource base etc. South Africa's NDC assumes commitment in addressing climate change based on science and equity promoting a flexible adaptation on sector policies and measures into national and sub-national policy frameworks to enable implementation of climate change adaptation programmes and projects. Sector adaptation plans will be integrated into broader sector plans consistent with relevant sector planning or regulatory legislation.

~~77.~~94. More recently, the Government has strived to allocate water resources to meet a growing economy's needs, to ensure food security, and maintain ecological integrity and environmental quality. It is noted in the UNFCCC report that the sustainable use of several transboundary aquifers would benefit from improved forms of management and investment in scientific understanding. Several large dams and inter-basin transfer schemes have been installed to address various needs such as urban development areas, water requirements of thermal power generation, mining centres and some regions of agricultural activity. "South Africa's groundwater aquifers are estimated to store roughly 235,000 Mm^3 of water (DWAF 2004) but the quality and availability of data on groundwater resources and their recharge rates compromise sound management decisions. Current estimates of exploitable groundwater range from 4,800 Mm^3 /yr, 6,000 Mm^3 /yr, 10,000 Mm^3 /yr and 19,000 Mm^3 /yr", (UNFCCC Report 2011). Groundwater is used extensively in rural and arid parts of South Africa. It is a significant resource to many irrigation farmers, small towns in more arid parts of the country and areas where surface-water resources are already fully committed. Rural communities in many parts of the country are largely or wholly dependent on groundwater. A result of the reliance on groundwater is indicated by the constant slow decline in groundwater levels, despite the seasonal fluctuations, attesting to unsustainable rates of use. Monitoring programmes in some regions are not adhered to and there is a lack of proper management of groundwater resources at national and local levels. Impacts of mining projects and their practice of groundwater removal are severe. Acid mine drainage is almost certainly the biggest threat to groundwater, especially in the vicinity of coal and gold mining activities. Further such exploitation of groundwater could have significant adverse environmental effects.

~~78.~~95. The South African National Development Plan (2012) envisions a better future by 2030 where no person lives in poverty, no one goes hungry, where there is work for all, and a nation united in the vision of the country's Constitution. The NDP aims to ensure the achievement of a "decent standard of living" for all South Africans by 2030 through 1. Better housing, water, electricity and sanitation; 2. Safe and reliable public transport; 3. Quality education and skills development; 4. Safety and security; 5. Quality health care; 6. Social protection; 7. Employment; 8. Recreation and leisure; 9. Clean environment; adequate nutrition.

Mozambique

~~79.~~96. The 2007 Mozambique National Adaptation Programme of Action has objectives related to early warning systems, improving family farmers' capacities to deal with adverse effects of climate change and strengthening the management of river waters. There has not been any specific groundwater strategy to guide the subsector's actions. Consequently, despite the fact that Mozambique's NDC aims at improving the capacity for integrated water resource management, including building climate resilient hydraulic infrastructures, actions are supported by non-robust planning tools, adapted mainly by those based on the surface water.

~~80.~~97.Mozambique is one of Africa's most vulnerable countries to climate change. The country is exposed to several extreme weather events including droughts, floods and tropical cyclones. Climate change is likely to exacerbate this vulnerability to flooding, as it is situated downstream of nine major river systems. Water resources in Mozambique are affected by pollution from mining, industrial, agricultural, and household waste. There are areas in the regions classified as semi-arid and arid (Gaza, Inhambane, and Maputo), where rain, even when above average, is inadequate. It results in critical water shortages leading to limited agriculture productivity. Strengthening research and systematic observation for the collecting data related to vulnerability assessment and adaptation to climate change, increasing effectiveness of land use and spatial planning are also included in NDC objectives related to sustainable use of water, activities and vulnerable groups dependent on availability and quality of water.

~~81.~~98.An analysis of the Mozambican Poverty Reduction Strategy Paper identifies five principal elements of the country which align very well with this proposed project's objectives. The principal elements include (1) increased investment in education, (2) sustained economic growth, (3) adoption of measures to raise agricultural productivity, (4) improved rural infrastructure, and (5) reduced numbers of dependents in households. This proposed project will contribute to improving agricultural productivity and rural infrastructure.

Zambia

~~82.~~99.The National Water Policy, revised in 2010 does not address issues of transboundary water management (including transboundary aquifers). The National Policy on Climate Change (NPCC) 2016's vison is "A prosperous and climate resilient economy by 2030". The NPCC identifies that the agricultural sector, which employs 67% of the labour force and contributes 16 to 20% of the country's national GDP, is highly dependent on rainfall and vulnerable to climate change. The resultant adverse impacts on crops, livestock and fisheries lead to reduced agricultural productivity, thereby contributing to food insecurity. Climate variability has kept a proportion of the population dependent on subsistence agriculture, below the national poverty line (NPCC, 2016). The Zambia National Climate Change Response Strategy (NCCRS, 2010) seeks to develop sustainable land use systems to enhance agricultural production, and to ensure sustainable management and resiliency of water resources under the changing climate. Zambia's NDC includes several objectives linked with water management, such as forest enhancement including natural regeneration and afforestation/reforestation; promotion of conservation agriculture activities leading to adaptation benefits and enhancing climate resilience, especially in rural areas; adoption and promotion of integrated water management (including ground and surface water monitoring systems), protection of catchment forests, improvement of monitoring systems for infrastructures, training for farmers, extension and technical staff on natural resources and climate change management and planning. In Zambia, poverty reduction is based on the following pillars, which aligns with this project as follows 1) Support to Infrastructure Development, which includes support to water and sanitation, energy and transport. 2) Support to Private Sector Development.

Zimbabwe

~~83.~~100. The current Zimbabwe Water Policy (2012) details support for groundwater management as follows: Data collection, management and research, integrated water resources management, Water and the hydrological cycle, Ownership of Water, Catchment as a unit of water management, Water for Primary needs. The Zimbabwe Climate Response Strategy has specific objectives to deal with promoting sustainable development, management and utilization of water resources under changing climatic conditions; promoting sustainable land-use systems that enhance agricultural production, ensure food security and maintain ecosystem integrity and address climate change through evidence-based research, technology development and transfer among others. The Strategy further deals with strengthening monitoring institutions for hydro-meteorological parameters; conducting more frequent yield assessments of surface and groundwater resources, and promoting water use efficiency in all sectors. It also outlines the development, rehabilitation, maintenance and protection of surface and groundwater resources. Zimbabwe's NDC gives particular focus to

strengthening management of water resources, including promoting and supporting water harvesting as a climate change adaptation strategy, with developing and rehabilitating and ~~maintenaning~~maintaining of surface and groundwater resources, and enhancing monitoring systems for hydro meteorological parameters.

~~84.~~101. The strategy for poverty reduction and sustainable development in Zimbabwe is anchored on seven key pillars, namely: (1) Agriculture productivity, growth and rural food security; (2) -Social sectors; (3) Private sector; (4) Infrastructure and climate change; (5) Environment and climate change; (6) Gender, Women and youth empowerment; and (7) Strengthening governance and institutional capacity. This project will contribute specifically to pillars one, two, four, five and six through the development and implementation of SAPs.

Regional Institutions and bodies

~~85.~~102. Key regional guiding documents for the management of transboundary aquifers are the i) SADC protocol on Shared Water Courses (2002) and Regional Strategic Plan-IV (RSAP IV-2016- 2020, currently being revised to RSAPV). In the SADC protocol on Shared Water Courses, the management of transboundary aquifers is implied in the definition of the Water Course. The Protocol also sets the foundation for the establishing a river basin, with a clear mandate on groundwater. The RSAP IV, set out the establishment of the SADC-GMI, with a mandate to spearhead and advocate for management of TBAs. Further, the SADC-GMI through its strategic business plan 2017-2023, acknowledges the work to be done in TBA.

~~86.~~103. The LIMCOM has been assisted in establishing the Limpopo Groundwater Committee (LGC), under the guidance of the SADC-GMI. The LGC is responsible for guiding the LIMCOM on groundwater-related issues in the Basin. SADC-GMI recently assisted the ZAMSEC with drafting a Terms of Reference for a Groundwater Committee for the Zambezi River basin.

~~87.~~104. While efforts have been made promote an enabling environment for groundwater management in River Basin Organisations and at national level. The implementing partners are cognisant of the inherent challenges presented by managing the invisible resource. The project will leverage the experiences of the SADC-GMI in implementing groundwater projects.

~~88.~~105. In terms of political and technical capacity of LIMCOM and ZAMCOM to support and sustain the implementation of project activities: The two RBOs are functional both politically and technically.

- The RBOs came into existence through agreements signed by the riparian states of the Limpopo Basin (Botswana, Mozambique, South Africa and Zimbabwe) and Zambezi Basin (Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe); that is, the LIMCOM Agreement of 2003 and the ZAMCOM Agreement of 2004.
- Both LIMCOM and ZAMCOM have secretariats based in Maputo and Harare, respectively. The functions of the LIMCOM and ZAMCOM Secretariats' include the following:
- To promote, support, coordinate and harmonise the planning, development and management of the water resources of the basins under their jurisdiction;
- To collect, evaluate and disseminate all data and information on the basins under their jurisdiction as may be necessary for the implementation of the LIMCOM and ZAMCOM Agreements;
- To execute the decisions of the councils of ministers of the RBOs and implement projects that promote the equitable and sustainable utilisation of the water resources of the basins under their jurisdiction.
- Both LIMCOM and ZAMCOM have three main organs:
- The Council of Ministers (CoM) is the highest decision-making body. This speaks to the political functionality of both river basin organisations. CoM meets at least once a year to provide policy

guidance in the context of promoting cooperative management and development of water resources.

- The Technical Committees - LIMCOM and ZAMCOM have technical committees that advise the CoM. The technical committees and their sub-committees are made up of experts from the Riparian states of the two basins. The technical committees have groundwater sub-committees. SADC-GMI signed MoUs with the RBO secretariats' to render technical and secretarial services to groundwater committees of the Limpopo and Zambezi Basins.
- The Secretariats - Both LIMCOM and ZAMCOM have established secretariats. The LIMCOM Secretariat is based in Maputo, Mozambique and the ZAMCOM Secretariat is based in Harare, Zimbabwe. The secretariats are responsible for the day to day running of the RBOs and implementation of projects and programmes. This speaks to the capacity of both commissions to support and sustain the project.

F. Relevant national technical standards

~~89.~~106. Technical standards in infrastructure preparation and construction will be central to the project. The project design will be assessed following IFAD's social, environmental and climate assessment procedures (SECAP), fully aligned with the AF and the SADC GMI Operational, Environmental and Social policies, which are flexible to enable tailoring to national requirements as per its 15 country membership. IFAD, SADC-GMI and technical experts housed in the project PMU will ensure compliance with relevant technical standards.

~~90.~~107. The SADC-GMI ESMF framework is the blue print for upholding Environmental and Social Governance principles and standards that will be followed by the project. SADC-GMI's Gender Equality and Social Inclusion Mainstreaming Strategy and Implementation Plan guide project implementation and ensures the upholding of the principles of gender equality and social inclusion. SADC-GMI has adequate expertise in the area of Environment and Social Management as well as GESI as the institution recruited for this position. As a result, SADC-GMI specialists will oversee compliance.

~~91.~~108. The compliance with the Environmental and Social Policy of the Adaptation Fund will be ensured during the project design and implementation phases. The compliance includes an initial screening for compliance against laws and requirements and the 15 principles of the Environmental and Social policy of the Adaptation Fund as outlined in Section K of this Concept Note. These standards and principles will be further consulted when conducting the feasibility study and developing the project proposal. The screening will inform the Environment and Social Management Framework (ESMF) for the project that will be developed during the design phase. The ESMF will guide the project implementation and ensure identified environmental and social risks are managed in each of the prioritised TBAs. While clarity will subsist prior to implementation of site-specific projects, it is noteworthy that SADC has several protocols and strategic plans that are relevant to the proposed project. All the project countries have developed policies, laws, strategies and plans for the conservation and management of natural resources, including land, water and biodiversity, policies, laws and plans on climate change, gender, HIV/AIDs, compensation and involuntary resettlement and marginalized people's rights. The site-specific screening that will be implemented during project design will identify gaps between regional and national policy and regulatory frameworks and donor (AF) requirements which, depending on the extent of the gaps identified, may trigger the appointment of external ESS specialists to conduct a formal gap analysis and provide advisory services in handling the gaps. This may include the development and implementation of ESMPs.

~~92.~~109. IFAD has established its Environmental and Social standards that set out specific requirements for social and environmental issues to be addressed in alignment with national priories. The nine standards are biodiversity strategy, resource efficiency and pollution prevention, cultural heritage, indigenous peoples, Labour and working conditions, community health and safety, physical and economic resettlement, financial intermediaries and direct investments,

and climate change which comply with the Fund and national policies and regulations for the selected countries.

110. A grievance mechanism that provides people affected by the project with an accessible, transparent, fair and effective process for receiving and addressing their complaints about environmental or social harms caused will be developed at design.

111. The proposed project interventions are supposed to be done within the governing legal framework of all the member states in this project. The project will also follow international best practices, including fulfilling the requirements of the Adaptation Fund, national Laws, Policies and Strategies of the member states. The proposed project is already complying with the laws governing its current activities. Specifically, the project will adhere to the following national country laws protecting the environment:
Botswana - Environmental Impact Assessment Act (Act No. 6 of 2005) (Cap. 65:07).
Malawi: - Environment Management Act (EMA), no 19 of 2017;
Mozambique -The Forestry and Wildlife Act (Law No.10/99) and The Environment Policy;
South Africa-The National Water Act, the National Forests Act, the National Environmental Management: Protected Areas Act, the National Environmental Management: Biodiversity Act and the Marine Living Resources Act;
Zambia -Environmental Protection and Pollution Control Act;
Zimbabwe - Environmental Management Act [Chapter 20:27];

G. Describe if there is duplication of project with other funding sources, if any.

~~93.~~112. Some relevant initiatives are being implemented in the region, and there is a partial overlap. There are also clear options for cooperation and synergies and a clear need for the region to do so, including: GEF and CIWA/WB support to SADC-GMI, which among other will support e.g., national groundwater focal groups (overlap with the present concept), monitoring and real-time database, DSS, etc., GEF and GIZ support several river basins in the SADC region incl. to some degree groundwater and conjunctive management dimensions (e.g., Limpopo, Orange-Senqu, Cubango-Okavango, Punge-Save-Busi basins, Cuvelai and Kunene basins). e.g., the GEF support to LIMCOM will develop a TDA and SAP for the Limpopo basin and has only limited funds to go into detail on groundwater. Complementarity will be built into the project and TDAs and SAPs processes designed and rolled out in a coordinated and synergetic fashion. Support to groundwater management and transboundary aquifers via IWMI and GRIPP partners such as UNESCO, IGRAC, BGS e.g., support to SADC-GMI, Tuli-Karoo aquifer, Ramotswa aquifer, Stampriet Aquifer. Same for GWP-SA supporting e.g., LIMCOM and GEF agencies World Bank, UNDP and IUCN. Existing knowledge exchanges between SADC region RBOs and shared groundwater, both supported by GEF IW projects and cooperation with GEF IWLearn will be utilised to share further the knowledge generated by the project.

~~94.~~113. The proposed project will seek to expand the work in TBAs in the SADC-region, given that of the ~30 TBAs in the region only 5 have been studied through TDAs and JSAPs, the above initiatives will be complemented through the project. Further, little has been done interms of implementing the JASPs, the project will contribute to this critical aspect.

~~95.~~114. The table below summarises, the key partners in the region in terms of i) focus areas in the region, ii) collaboration with the Sustainable Groundwater Management in the SADC Member States Project Phase I and iii) envisaged collaboration with the Sustainable Groundwater Management in the SADC Member States Project Phase II and iv) areas for further collaboration under this proposed project.

Partner (s)	Expertise	Current / Previous Work in the Region	Proposed Collaboration with proposed project
IGRAC	Groundwater Monitoring and Information Systems	Groundwater data collection and management in the SADC region	• Design set up and integration of groundwater monitoring systems in the 4 TBAs.

			• IGRAC has developed the current SADC-GIP, the proposed work will feed data into the SADC-GIP. • Will also build capacity in the RBOs related to Groundwater Information Systems
UNESCO-IHP	Governance of Transboundary Groundwater aquifers.	GGRETA III, seeks to amongst other issues expand the setting up of the MCCM in the for the Ramotswa TBA Development and endorsement of the ORASECOM Stampriet Transboundary Aquifer System (STAS)	• The setting up of the MCCM for the Ramotswa TBA will complement the project. The MCCM will serve a critical role of implementing the Ramotswa JSAP • There are a lot of lessons learnt to be drawn from the work that UNESCO- IHP is implementing in ORASECOM and LIMCOM.
CIWA/ GEF/ WORLD BANK	Regional Groundwater Management	Establishment of the SADC-GMI and centre to advance sustainable groundwater management in the SADC region Development of JSAP for TBAs including the TULI Karoo in Collaboration with IWMI	• The SADC- GMI will in the period 2022-2026 continue to support the LIMCOM with Groundwater Governance through e.g., development of a Groundwater Strategy and coordinating the Work of the Limpopo Groundwater Committee • The project will rely on the capacity of the SADC to convene stakeholders around groundwater Governance and Management in the SADC
IWMI	Agriculture Water Solutions Transboundary Aquifer Governance Design of regional Groundwater Monitoring Numerical Groundwater Modelling	Involved in the Ramotswa, Shire and Tuli Karoo, development of TDAs and JSAPs for the Transboundary Aquifers. Currently working on the KAZA	• Endorsement of the Ramotswa JSAP through the LIMCOM structures (the Limpopo Groundwater Committee) • IWMI will be a key partner under the proposed project.
Resilient Waters Program (USAID)	Building Climate resilience in the region	Supporting the groundwater Policy legal and Institutional (PLI) review and Roadmap development in Limpopo Basin	• The PLI project will complement the exploration of TBA governance in the Limpopo River Basin.
GIZ	Regional Transboundary Water capacity building	Assisted the SADC-GMI with capacity building aimed at integrating Groundwater Management into River Basin Organisations	• Envisaged to collaborate around the issues of capacity building
BGR	Detailed Physical Hydrogeological Investigations of transboundary Groundwater systems	Work in the CUVECOM Ohangwena aquifer.	• Approaches implemented in the Ohangwena aquifer will be extended in the TBAs

H. Knowledge Management

~~96.~~115. The approach to Knowledge Management will be two pronged, ensuring both learning from knowledge generated in similar projects, and disseminating of the learning from this project to others in the region and wider. The SADC mandates SADC-GMI as a Regional Centre of Excellence in groundwater, to act as a regional convenor of knowledge and a dissemination hub. It has formed trusted relationships with the relevant government institutions in each SADC Member State, therefore it is ideally placed. SADC-GMI is the Technical Adviser of all the RBOs in SADC and sits on all the Groundwater Committees, TBA structures and governance meetings. This provides an opportunity for SADC-GMI to facilitate cross-learning, and, thus knowledge management across the RBOs. Additionally, it should be mentioned that the governance mechanism that the project

will support will bring together different stakeholders – this will not only support cross-pollination of ideas and lessons, but also allow afford the project to disseminate generated knowledge and lessons beyond the project circles. Bringing different stakeholders together will foster scaling up some of the best practices used in this project.

~~97.~~116. Knowledge from the project will be primarily generated via Output 1.1 and 1.2, through TDAs and the establishing of 48 automatic monitoring boreholes to collect data on groundwater quality and quantity, which will be fed into regional information systems. There is an opportunity for co-creation of knowledge under output 1.1 with different stakeholder groups during the TDA/JSAP processes. All data generated will be inputted in real-time into the GMI's Groundwater Information Portal. This regional data portal collates and shares data sets from boreholes to assist with decision making across all TBAs and RBOs in the region. Furthermore, the project's monitoring and evaluation process will generate lessons and best practices on TBA management and climate change adaptation in TBA areas, which will be shared through the GMI's Groundwater Information Portal.

Learning

~~98.~~117. Learnings on implementing TDAs and the SAPs will be sought from the aquifers where the process has already been undertaken, such as the Ramotswa and Stampriet Aquifers. The SADC-GMI implemented TDA/SAP work in the Shire TBA (shared between Malawi and Mozambique), also implementing a similar project in the Eastern Kalahari Karoo Transboundary Aquifer (shared between Botswana and Zimbabwe) and is also collaborating with the International Water Management Institute (IWMI) to implement a TDA/SAP in the Tuli-Karoo TBA (shared between Botswana, Zimbabwe and South Africa). Through these processes the SADC-GMI has built capacity implement TDA/SAP projects effectively Understanding the key success factors from these projects will be important to designing and adapting the process in each specific country context.

Dissemination

~~99.~~118. The dissemination activities will aim to support decision-makers and other stakeholders involved in the governance of transboundary aquifers, with relevant information. The following are planned as part of the Knowledge Management initiatives:

1. For each riparian country, a research dissemination workshop will be held
2. Dissemination of research results on existing web-based platforms through a two-pronged approach:
   a. Data collected and generated for each TBA (boreholes, water quality, yields, aquifer maps, groundwater contour maps), will be made available to stakeholders through the SADC Groundwater Information Portal (SADC-GIP). This is owned and maintained by the SADC-GMI who will create a dedicated platform within the portal for each TBA.
   b. Reports collected and generated will be distributed through the SADC Groundwater Literature Archive (SADC-GLA), a portal dedicated to making groundwater literature available to stakeholders.
   c. Dissemination of knowledge and information through national, regional and international fora.

i. At National level, the National Focal Groups on Groundwater, which the SADC-GMI is implementing in all the SADC Members States, will be used. The National Focal Groups have the primary function of advocating for national and transboundary groundwater management. They comprise all the key groundwater stakeholders in each Member States.

ii. At the regional level, knowledge will be disseminated through platforms such as::

- The Annual SADC groundwater conference
- Southern Africa Development Community (SADC) River Basin Organisations (RBOs)
- The Annual WaterNet Symposium
- SADC Multi-Stakeholder Water Dialogue

   d. The SADC-GMI has a network of international partners through which the knowledge generated can be disseminated, this Network includes, UNESCO-IGRAC, UNESCO-IHP, British Geological

Survey, the BGR, IWMI, CRIDF, AMCOW etc. SADC-GMI constantly organize joint events to elaborate on regional groundwater development and regional management with these international partners. Hence, they provide a ready platform through which to disseminate results from the TDA/ SAPs. Community feedback will be through National Focal Groups, which provides an inclusive platform for in-country stakeholders. Site educational tours to successful pilots will be organized at the regional level through the SADC's sub-committee on Hydrogeology which is convened by the SADC-GMI.

Scaling up potential of the project

~~100.~~119. Factors supporting the scaling-up of the project approach across the Southern Africa region and beyond are detailed below.

- The project will demonstrate proof-of-concept for the sustainable management of TBAs, and how this supports climate change adaptation of vulnerable communities in these areas. This helps leveraging additional finance from funds such as GCF for scale up, particularly because of the wider coverage to which the project approach is applicable.
- Given the political support the project will receive via the SADC-GMI, RBOs and the JSAP development process, financial and operational self-sustainability will be inherent. In addition, as improved incomes through the farms and agribusinesses benefitting from the project's adaptation interventions accrue, the cost-effectiveness of the approach will become apparent, fostering interest and strong demand from local stakeholders, as well as leveraging resources to support scaling up. This will also be supported by the project's awareness-raising, knowledge dissemination and capacity-building activities.
- The knowledge generated from TDAs/JSAP, processes could be documented and disseminated for replication in other aquifers and RBOs.

I. Stakeholder Engagement

~~101.~~120. Effective stakeholder engagement develops a "social license" based on mutual trust, respect and transparent communication between an organisation and its stakeholders. Robust, equitable and fair stakeholder engagement and consultation are central to this work programme. The transboundary nature means that without firm stakeholder agreement on both sides of the national border, the aquifer development will not succeed. For this reason, the GMI have developed a robust approach to stakeholder engagement, based on the foundation of SADC policies and refined during the three previous SAP processes and the implementation of infrastructure projects in all 1~~5~~6 SADC Member States. This involves stakeholder identification and analysis, timely disclosure of project information, inclusive dissemination of and access to information, public participation, consultations and feedback, and access to a mechanism to raise and remedy grievances.

~~102.~~121. To better understand priority issues and raise consensus on joint (cross-border) management of water resources in the aquifer system, joint stakeholder dialogues will be held with participation of government representatives, national experts and other interest groups.

The stakeholder dialogues will: i) Place emphasis on inter-sectorial participation and consultation; ii) Seek stepwise consensus building through validation workshops to ensure a broader stakeholder buy-in; iii) Validate the options for interventions at technical, management, socio-economic and policy levels

The Stakeholder engagement techniques will be grounded in International Best Practices and will include the following: i) One-on-one interviews with key representatives of identified stakeholder groups, ii) Formal meetings. iii) Workshops, iv) Focus group meetings

~~103.~~122. SADC-GMI will rely on its network of civil society and government partners to identify 'left behind' groups for targeting and inclusion. Focus will be on ensuring

the voices of women, the elderly, youth, disabled and other vulnerable groups are heard –particularly important when determining the priority actions for agricultural adaptation measures, due to the sector traditionally being implemented by women but controlled by men. SADC-GMI will also ensure appropriate consultation and engagement with smallholder farmers, not just commercial agri-business.

~~104.~~123. At this stage, the following stakeholders will be consulted at the different stages of the project. Cognisance must be taken from a full list of stakeholders through a stakeholder mapping exercise at the onset of project implementation.

~~105.~~124. The table below summarises, the different stages of the project cycle and the key stakeholders to be consulted.

Project Stage	**Project formulation**	**TDAs**	**JSAPs**	**Implementation of JSAPs through agribusiness, infrastructure development, resource protection**
Key Stakeholder	Groundwater national Focal Persons National Focal Groups in the Member States Ministries/Departments responsible for Agriculture Local Authorities within the TBA. Youth and Women organisations Farmer organisations Climate Focal Persons for each Member State. International cooperating partners active in the TBAs	Groundwater national Focal Persons National Focal Groups in the Member States International cooperating partners active in the TBAs	Groundwater national Focal Persons National Focal Groups in the Member States Ministries/Departments responsible for Agriculture Local Authorities within the TBA. Youth and Women organisations Farmer organisations Climate Focal Persons for each Member State. International cooperating partners active in the TBAs Traditional Leadership	Groundwater national Focal Persons National Focal Groups in the Member States Ministries/Departments responsible for Agriculture Local Authorities within the TBA. Youth and Women organisations Farmer organisations Climate Focal Persons for each Member State. International cooperating partners active in the TBAs Traditional Leadership

~~106.~~125. To inform the development of the Concept Note for the proposed project, consultations, were undertaken with regional and national level stakeholders involved in managing of groundwater resources, TBAs in the SADC region. The consultations were used to *inter alia*: i) introduce the stakeholders to the project concept; ii) collect information to support the development and design of the Concept Note; iii) identify indicative pilot sites to be targeted by the project; iv) better understand the adaptation needs of the region and how these could be addressed; v) discuss potential alignments and complementarities with relevant past and ongoing initiatives, as well as national and regional priorities; vi) identify other stakeholders that could contribute to and benefit from the implementation of the proposed project; and vii) foster buy-in and support of the stakeholders for the proposed project. The stakeholder consultation process also drew from the "Policy, Legal and Institutional Development for Groundwater Management in the SADC Member States" (GMI-PLI) project Gap Analysis and Action Plan: Scoping Reports for Botswana, Malawi, Mozambique, South Africa, Zambia and Zimbabwe, which were developed in 2019. The reports were informed, in part, by stakeholder consultation, and provide an overview of the existing gaps in policy, legislation, strategy, guidelines and institutional frameworks and further suggest enablers required to unlock gaps/challenges related to groundwater management.

~~107.~~126. A list of the stakeholders consulted is presented in the table below. In total, 36 stakeholders were consulted, including 73 people (23 female and 50 male). Given the geographic scale of the project, extensive consultations at the local level were not logistically possible during Concept Note development. However, more intensive consultations will be carried out during full Funding Proposal development — see additional detail below. The detailed results of the consultations are presented in Annex 3: Stakeholder Consultation Report. As needed, this information has been intergrated into the Concept Note. A detailed stakeholder consultation plan will be developed

to inform the funding Proposal development. While the stakeholders who were consulted during Concept Note development will be engaged continuously during the development of the Funding Proposal, additional stakeholders will also be consulted, including those at the local level, such as vulnerable communities, civil society organisations, non-governmental organisations, etc., to ensure that all needs and perspectives are considered.

Region/Country	Stakeholder group	Stakeholder
Malawi	National Government	Water and Environmental Sanitation Network
		Department of Water Resources
		Groundwater Division, Department of Water resources
		Department of Environmental affairs
	Academia and Research	Mzuzu University
	CSO	BASE flow Malawi (NFG representative)
	Development agency	UNICEF Malawi
Zimbabwe	National Government	Glimss Consulting (NFG representative)
		Zimbabwe National Water Authority
	Local Institution	Mzingwane Catchment Council ~~Upper Manyame Sub Catchment Council~~
Zambia	National Government	Ministry of Water
		Government of Zambia
South Africa	National Government	Department of Forestry, Fisheries and the Environment
		Department of Agriculture, Land Reform and Rural Development
		Department of Water and Sanitation
Mozambique	National Government	National Directorate of Water Resources Management
		Regional Water Administration South
		Investments and Assets Fund for Water Supply
		Administration of Water and Sanitation Infrastructures
	Academia and Research	University of Mozambique
		Consultec
Botswana	National Government	Department of Water Affairs
		Ministry of Agriculture
		Department of Environment
		Department of Energy
		Department of Meteorological Services
		Chamber of Mines
	Academia and Research	Botswana Investment and Trade Centre
		University of Botswana
		Botswana Geoscience Institute
	CSO	Solar Association Botswana
		Botswana Climate Change Network
		Forest Conservation Botswana
		Botswana Investment and Trade Centre
	Regional Institution	Okavango River Basin Water Commission
SADC	River body organisation (RBO)	Zambezi Watercourse Commission
		Limpopo Watercourse Commission

~~108.~~127. In summary the stakeholders noted that the proposed project was aligned with national and basin-level (LIMCOM and ZAMCOM) priorities and related to sustainable water management and increasing climate resilience. However, the main issues raised included a need for the project to prioritise the following:

- To improve monitoring of groundwater use by using equipment to ensure the sustainable use of groundwater in the face of climate change and to avoid maladaptation.
- The need to increase capacity building for local-level stakeholders through training in climate change adaptation related to the management and use of groundwater resources
- Support with Infrastructure, especially, climate-smart Infrastructure for groundwater use and management, to support community adaptation.
- Improve knowledge management to ensure lessons learned and best practices on sustainable groundwater management are shared within the country and region to inform scaling up and replicating the project's activities. A particular need for the development of a harmonised data

portal for the processing of data for groundwater resources management was mentioned by national stakeholders.

- A need to address the vital issue of groundwater data collection, analysis and information management as the foundation for improved management and cooperation of stakeholders – required to understand climate change impacts
- Improve agricultural production through improved access to groundwater for irrigation and the introduction of sustainable climate-resilient farming practices
- Implement aquifer management in priority aquifers informed y TDAs and JASP.

J. Provide justification for funding requested

~~109.~~128. The programme of work has been developed to balance the needs of research and stakeholder engagement to inform action, with concrete adaptation activities on the ground. One can only happen with the other, yet this often takes time and is often not the priority for adaptation funding. For this reason, aquifers in two different stages of development have been selected, to be able to build the groundwork for action in one and undertake the implementation and bring about adaptation impact in the other.

~~110.~~129. The challenges of a dynamic and declining water availability under future climate projections will lead to greater pressure to exploit unrealised and little-known groundwater resources. The project aims to fill an extremely relevant gap linked with the lack of solid data series that can feed the decision-making processes related with underground water resources management. With the strengthening and integration of the monitoring systems, and the capacity building provided, the project will contribute developing of a robust regional information system, assisting local authorities and farmers to better assess risks and adopt different approaches to address the impacts of climate change and variability. Comprehensive adaptation actions are required to ensure water security for Africa's most vulnerable smallholder farmers in the face of climate change. However, the investments proposed in this project cannot be undertaken by the countries alone, especially in a post-COVID-19 financial scenario. The economic slowdown caused by the COVID-19 pandemic also reduces the capacity of the countries to make huge financial contributions to development programmes as they must reorient financial resources to mitigate the effects of the pandemic. In addition to investments in urgently needed measures, the project will develop mechanisms that will allow sustainability of long-term adaptation activities.

K. Sustainability of the project outcomes

~~111.~~130. Sustainability of project outcomes will be ensured in several ways. Implementation of the project will be through existing government structures, in particular through the local leadership and extension network, which will be strengthened to augment the numbers of extension officers and agents on the ground and capacities and capabilities to support farmer groups and organisations. This will ensure institutional support for the project activities after the grant ends.

~~112.~~131. The TDAs would be undertaken using the most advanced groundwater and climate change modelling techniques, ensuring that the models are built on the highest quality data available and model future climate predictions appropriately to ensure results will remain relevant under all future scenarios.

~~113.~~132. Decision-making will be undertaken based on sustainable groundwater abstraction rates in line with the aquifer recharge rates, to ensure that the utilisation of the water resources is sustainable and does not lead to maladaptation. While admitting the role of clean energy in groundwater abstraction for livelihoods, the resultant increased abstraction will need to be managed to safe abstraction limits. Incentives and control measures will be devised, for example increasing the irrigation scheduling expertise of the farmers in collaboration with the relevant government departments/agencies and stakeholders, use of water-saving interventions such as mulching, use of water-efficient irrigation systems (drip/ sprinkler irrigation) and lastly use of legislative instruments (water use licences).

~~114.~~133. The SAP process will be based on tried and tested national stakeholder engagement processes. It will be designed to be equitable, fair and give due time to ensure that all parties buy into the final product, to ensure long-term commitment to the agreement. This process is essential, and has the potential to uncover potentially conflicting priorities between member states, which, if not facilitated appropriately, could diminish the sustainability of the outcomes.

~~115.~~134. The sustainability of the groundwater infrastructure will be ensured in a number of ways. Firstly, the infrastructure specifications will be determined based on future water demand and availability under climate change. Secondly, the preparation studies will be robust and adhere to international best practise across all areas, including social and environmental assessments. The SADC GMI has recently developed an Environmental and Social Policy, which is in line with the requirements of the World Bank, Adaptation Fund, GCF, and IFAD's SECAP.

~~116.~~135. Thirdly, the beneficiaries will be trained on the operation and maintenance of the infrastructure. Fourthly, livelihood projects and components will be implemented. The capacity of smallholder farmers will be built, which will enable them to increase their income and, in turn, their ability and willingness to pay for the water, to provide revenues for ongoing operation and maintenance.

~~117.~~136. Strong and inclusive stakeholder engagement processes will seek to ensure that there is full buy-in at each decision-making stage, and at implementation. It will be important to identify the infrastructure priorities of each affected party, including government, water authorities, the private sector, residents, farmers, and other beneficiaries, and to include them in the prioritisation process duly.

~~118.~~137. The SADC-GMI has commenced formulation of National Focal Groups (NFGs) in the SADC Member States. These NFGs are led by the National Focal person, with NFG including all stakeholders identified through a stakeholder mapping exercise. Through this structure the SADC-GMI has successfully mobilised stakeholders in the previous TDA/SAP processes it has undertaken. This structure, is very important in consulting with the end users of the infrastructure to be developed and taking on board their aspirations and preferences. SADC-GMI will seek to directly consult the following groups of end users through their local structures: farmer organisations, local authorities, water user associations, indigenous people, youth and women organisations (including the disabled) and the River Basin Organisations. Protocols will be set in place for end-user participation in the conceptualisation, design and implementation of the interventions, end user participation will be viewed as an integral process of the selection of preferred options to ensure sustainability of the infrastructure. Local government structures have worked with the end users and will continue to do so.

~~119.~~138. The GMI will draw upon its GESI Mainstreaming Strategy and Implementation Plan of 2021 and IFAD policy on gender quality and women's empowerment (2021) fully aligns with the Adaptation Fund's Gender Policy. The strategy makes provision for assessing the projects impacts on women and vulnerable groups and determining ways to maximise the benefits for these groups and enhance inclusivity. In line with IFAD's target that all projects benefit at least 50% women and 25% youth, the gender aspects will also be taken into account to ensure women's equal access to project benefits. Gender-sensitive climate-smart technologies and practices and barriers to participation (e.g., lack of childcare facilities, practices that increase women's workload, and the timing of educational events that interfere with women's daily schedules). These issues, including gender-related challenges in agricultural development, will be addressed through the project design and will be further investigated in the proposal stage and supported through gender-responsive budget allocation.

~~120.~~139. The project will provide technical contributions through coordinating structures at the groundwater management Hubs on sustainable groundwater management practices and the Projects Steering Committee. The project will produce reader-friendly and eye-catching knowledge products, including audio-visual material, based on the evidence generated in English and local languages.

Workshops will be held to disseminate of results to policy makers to advance policy development on ground water management and climate change adaptation practices. This will aid the sustainability and longevity of the support for the overall developed solutions.

~~121.~~140. Sustainability in the adoption of sustainable groundwater practices will be promoted by supporting a motivated and knowledgeable extension service through recruitment of facilitators to fill the gaps, greater technical support from the extension network and investing in work 'enablers' at the extension level to secure greater involvement in results monitoring and reporting. This is intended to improve the institutional support given to the farmer groups and de facto improve the quality of the demonstration plots. Sustainability of adoption rates will be promoted through working with women's and men's groups separately. Participatory approaches used for the agricultural component will support farmers priorities based on farmers' knowledge of what works and challenges to ensure relevance. Sustainability will also be strengthened through agro-biodiverse farming strategies, which are intended to contribute to a stabilisation of production yields, and associated means to continue sustainable livelihood strategies in future years, but with minimum levels being substantially higher than at present, due to improved varieties based on landraces adapted to the availability and sustainable use of groundwater resources and recharge of aquifers. The farming strategies are expected to contribute to improved water infiltration in the productive agricultural landscape. The project will implement a participatory approach based on indigenous knowledge and farmer to farmer knowledge sharing.

~~122.~~141. Sustainability will also be enhanced and supported by technical capacitation on environmental management and monitoring and awareness will promote best practices by water end users.

L. Overview of the environmental and social impacts and risks relevant to the project.

The potential negative environmental and social impacts associated with the project activities in Components 1 – 3 are expected to focus on limited physical footprint for the investments. Considering the project budget of an estimated USD10million going to strategic small-scale infrastructure projects spatially dispersed in the TBAs, the environmental and social risk rating, as further elaborated in the table on the next page is considered **moderate** at this stage and hence classified as **Category B**. Activities to be financed under the project will include drilling wells and monitoring boreholes, small sand dams and riverbank infiltration systems, and hand-dug wells. The other initiatives will entail installing mitigation measures to accrue environmental and social benefits. Impacts that may arise include localized loss of vegetation, soil erosion and degradation, minor soil and surface water pollution and minor dust and noise emissions. The activities are further likely to generate small-scale construction hazardous and non-hazardous waste, occupational health and safety concerns to both contracted workers and communities, including the spread of communicable diseases, sexually transmitted diseases and possibly minor risks of gender-based violence, sexual exploitation or sexual harassment and issues relating to labor and working conditions. Since the impacts are considered localized and of short duration, they can be mitigated by engaging good practice measures and preparing site-specific environmental and social management plans (ESMPs). It is not expected that the project will require land acquisition or result in loss of livelihoods and assets as the investments are expected to take place within already established community areas. Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities are present in several SADC Member States, however, the project areas and countries where such sub-grant projects will take place are not yet known. This will be determined during the environmental and social assessment for the respective site-specific projects. The Environmental and Social Management Framework (ESMF) makes provisions for the screening and advanced identification of the presence and collective attachment to proposed project sites of indigenous peoples/sub-Saharan African historically underserved traditional local communities. Further assessments and feasibility studies at the full proposal development stage will substantiate and further inform the project's Environmental Social and Principles (ESP) categorisation. The assessments and studies will be complemented by additional consultations with key stakeholder's including communities to ascertain the project ESP category.

At this concept stage, envisaged project activities have been screened against the 15 ESP. The risks identified during CN stage are preliminary and an environmental and social risk assessment will be conducted at full proposal stage. The expansion or intensification of agricultural activities following the improved water availability may lead to localised land clearing, loss of biodiversity, increased erosion risk, pollution of surface water and land resources and social risks related to competing uses of water resources. The construction of agri-business facilities and agricultural production infrastructure such as irrigation schemes and boreholes may result in vegetation clearing, increased waste generation, economic displacement and influx of migrant labour with social implications on community health and labour conditions. The use of groundwater for irrigation might result in over extraction resulting in a lowering of the water table. Other associated risks include stream flow reduction and, riparian and wetland ecosystems degradation. Despite the threat to depletion of groundwater, deterioration, of groundwater quality is also perceived as a risk emanating from the project. These risks, if not mitigated, will further reduce the resilience of communities to climate change. Achieving sustainable groundwater management demands coordination with surface water management for conjunctive use and that local groundwater users, technical specialists and policy maker's work together to implement multi-actor, collaborative and participatory strategies for sustainable groundwater management.

The potential negative environmental and social impacts associated with the agricultural activities and the development of infrastructure in the TBAs are minimal, localized, and reversible environmental and social impacts – see ESP risk compliance checklist below. Therefore the project is classified as **Category B**. Further assessments and feasibility studies at the full proposal development stage will substantiate and further inform the projects Environmental Social and Principles (ESP) categorisation. The assessments and studies will be complemented by additional consultations with key stakeholder's including communities to ascertain the project ESP category. At this concept stage, envisaged project activities have been screened against the 15 ESP. The risks identified during CN stage are preliminary and an environment and social risk assessment will be conducted at full proposal stage. The expansion or intensification of agricultural activities following the improved water availability may lead to localised land clearing, loss of biodiversity, increased erosion risk, pollution of surface water and land resources and social risks related to competing uses of water resources. The construction of agri-business facilities and agricultural production infrastructure such as irrigation schemes and boreholes may result in vegetation clearing, increased watse generation, economic displacement and influx of migrant labour with social implications on community health and labour conditions. The use of groundwater for irrigation might result in over extraction resulting in a lowering of the water table. Other associated risks include stream flow reduction and, riparian and wetland ecosystems degradation. Despite the threat to depletion of groundwater, deterioration, of groundwater quality is also perceived as a risk emanating from the project. These risks, if not mitigated, will further reduce the resilience of communities to climate change. Achieving sustainable groundwater management demands coordination with surface water management for conjunctive use and that local groundwater users, technical specialists and policy maker's work together to implement multi-actor, collaborative and participatory strategies for sustainable groundwater management. The proposed project interventions are supposed to be done within the governing legal framework of all the member states in this project. The project will also follow international best practices, including fulfilling the requirements of the Adaptation Fund, national Laws, Policies and Strategies of the member states. The proposed project is already complying with the laws governing its current activities. Specifically, the project will adhere to the following national country laws protecting the environment

Zambia

Environmental Protection and Pollution Control Act

uth Africa

The National Water Act, the National Forests Act, the National Environmental Management: Protected Areas Act, the National Environmental Management: Biodiversity Act and the Marine Living Resources Act.

Mozambique

The Forestry and Wildlife Act (Law No.10/99) and The Environment Policy

Environment Management Act (EMA), no 19 of 2017

Zimbabwe

Environmental Management Act [Chapter 20:27]

Botswana

Environmental Impact Assessment Act (Act No. 6 of 2005) (Cap. 65:07).

Category Project: Category B.

Checklist of environmental and social principles	Condition or requirement	Current status	Potential impacts and risks – further assessment and management required for compliance
Compliance with the Law	Projects/programmes supported by the Fund shall be in compliance with all applicable domestic and international law.	Incomplete	No risk - Adherence to laws will be ensured by observing the SADC protocols. Necessary approvals will be obtained prior to any infrastructure development.
Access and Equity	Projects/programmes supported by the Fund shall provide fair and equitable access to benefits in a manner that is inclusive and does not impede access to basic health services, clean water and sanitation, energy, education, housing, safe and decent working conditions, and land rights. Projects/programmes should not exacerbate existing inequities, particularly with respect to marginalized or vulnerable groups.	Incomplete	Further assessment on access will be undertaken during the design Low risk -The SAPS, TDAs and Stakeholder consultation will ensure improved access to natural resources for different users. Equity will also be ensured by adhering to the protocols and in the implementation of the SAPs.
Marginalized and Vulnerable Groups	Projects/programmes supported by the Fund shall avoid imposing any disproportionate adverse impacts on marginalized and vulnerable groups including children, women and girls, the elderly, indigenous people, tribal groups, displaced people, refugees, people living with disabilities, and people living with HIV/AIDS. In screening any proposed project/programme, the implementing entities shall assess and consider particular impacts on marginalized and vulnerable groups	Incomplete	Marginalised and vulnerable groups will be a key target group for the project starting with their identification during the design phase. The targeting strategy that will be developed for the project implementation will ensure social inclusion and the reach of marginalised and vulnerable groups in the TBAs
Human Rights	Projects/programmes supported by the Fund shall respect and where applicable promote international human rights.	Incomplete	Human rights will be respected during the project implementation with specific considerations also made during project design. IFAD as a UN specialized agency will ensure adherence to various conventions with the ratifications made in the different countries where the project will be implemented. Particular attention will be devoted to the right to water and food as basic needs to face the challenges of climate change variability.
Gender Equality and Women's Empowerment	Projects/programmes supported by the Fund shall be designed and implemented in such a way that both women and men (a) have equal opportunities to participate as per the Fund gender policy (refer to Annex 4 for details); (b) receive comparable social and economic benefits; (b) receive comparable social and economic benefits; and (c) do not suffer disproportionate adverse effects during the development process.	Incomplete	Low risk- The focus on gender equity and empowerment is illustrated through the target to reach at least 50% women and project activities are designed such that tangible, economic benefits accrue to women.
Core Labour Rights	Projects/programmes supported by the Fund shall meet the core labour standards as identified by the International Labor Organization.	Incomplete	Low risk- The ESMF that will be developed to guide project implementation will assess the risk related to labour conditions particularly for the infrastructure development and agri-business facilities. Specific measures will be articulated to adhere to acceptable working conditions and respect labour rights.
Indigenous Peoples	The Fund shall not support projects/programmes that are inconsistent with the rights and responsibilities set forth in the UN Declaration on the Rights	Incomplete	Low risk - Indigenous peoples and their territories are not expected to be adversely impacted by the project activities.

	of Indigenous Peoples and other applicable international instruments relating to indigenous peoples.		However, during design, indigenous peoples in the TBAs will be identified and specific activities to ensure their effective participation in the project activities included. The principles of Free Prior and Informed Consent will also be applied to project activities.
Involuntary Resettlement	Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids or minimizes the need for involuntary resettlement. When limited involuntary resettlement is unavoidable, due process should be observed so that displaced persons shall be informed of their rights, consulted on their options, and offered technically, economically, and socially feasible resettlement alternatives or fair and adequate compensation.	Incomplete	The project activities are not expected to result in any involuntary resettlement
Protection of Natural Habitats	The Fund shall not support projects/programmes that would involve unjustified conversion or degradation of critical natural habitats, including those that are (a) legally protected; (b) officially proposed for protection; (c) recognized by authoritative sources for their high conservation value, including as critical habitat; or (d) recognized as protected by traditional or indigenous local communities.	Incomplete	Low risk - Project activities are not expected to destroy natural habitats as they will conform to the ESM Framework
Conservation of Biological Diversity	Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids any significant or unjustified reduction or loss of biological diversity or the introduction of known invasive species	Incomplete	Low risk - Project activities are designed to converse biodiversity
Climate Change	Projects/programmes supported by the Fund shall not result in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change.	Incomplete	Low risk :The project activities are designed to mitigate against the impact of climate change on vulnerable and marginalised
Pollution Prevention and Resource Efficiency	Projects/programmes supported by the Fund shall be designed and implemented in a way that meets applicable international standards for maximizing energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants	Incomplete	Low risk- Appropriate measures will be taken in project design to ensure pollution prevention. The project will optimise resources through use of existing structures in member states
Public Health	Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids potentially significant negative impacts on public health	Incomplete	Low risk-The ESMF stipulates the measures to be taken to ensure public health and safety and the project activities
Physical and Cultural Heritage	Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids the alteration, damage, or removal of any physical cultural resources, cultural sites, and sites with unique natural values recognized as such at the community, national or international level. Projects/programmes should also not permanently interfere with existing access and use of such physical and cultural resources.	Incomplete	No risk- All project activities are expected to preserve physical and cultural heritage
Lands and Soil Conservation	Projects/programmes supported by the Fund shall be designed and implemented in a way that promotes soil conservation and avoids degradation or conversion of productive lands or land that provides valuable ecosystem services.	Incomplete	Low risk-The project activities will be implemented in collaboration with relevant line ministries of agriculture and their experts will guide in land and soil conservation methods

~~123.~~142. During the detailed design phase of the project, the following aspects for compliance with the AF Environmental and social risks will be further assessed: Compliance with international and domestic law, provide fair and equitable access to benefits in a manner that is inclusive; avoid imposing any disproportionate adverse impacts on marginalized and vulnerable groups; respect and where applicable promote international human rights; promote Gender Equality and Women's Empowerment; meet the core labour standards as identified by the International Labour Organization; not implement projects inconsistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments relating to indigenous peoples; avoids or minimizes the need for involuntary resettlement; avoid unjustified conversion or degradation of critical natural habitats; prevent any significant or unjustified reduction or loss of biological diversity or the introduction of known invasive species; avoid any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change; maximize energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants; avoid potentially significant negative impacts on public health; prevent the alteration, damage, or removal of any physical cultural resources, cultural sites and sites with unique natural values recognized as such at the community, national or international level; promote soil conservation and avoid degradation or conversion of productive lands or land that provides valuable ecosystem services.

~~124.~~143. The project's approach to groundwater sustainability is centred around: i) understanding the limits/capacities of the groundwater systems; ii) working towards policy law and institutions for effective groundwater governance; and iii) paradigm shift towards economic principles and instruments for sustainable groundwater management and social organisation around groundwater management. The Collaborative model for sustainable groundwater management is summarized in the Figure 6. This project will seek to work towards the collaborative model.

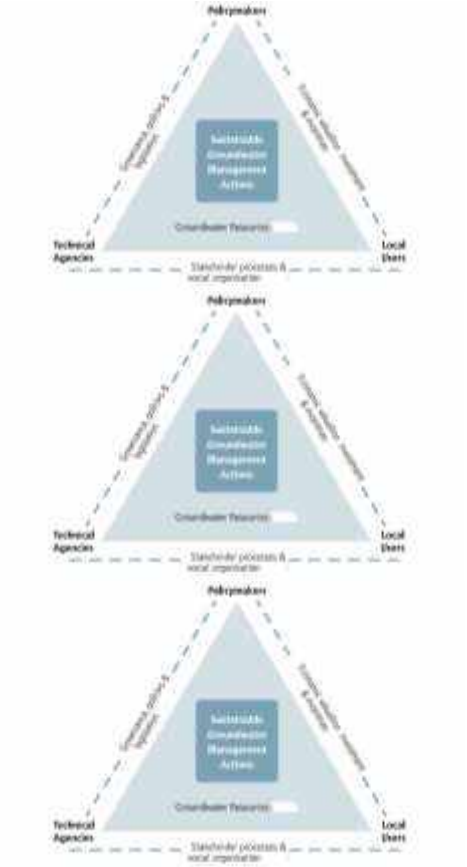


Figure 6. Source: Smith, M., Cross, K., Paden, M. and Laban, P. (eds.) (2016). Spring – Managing groundwater sustainably. IUCN, Gland, Switzerland.

~~125.~~144. Installation of monitoring systems and the generation of early warning information to mitigate the risk of groundwater depletion and deterioration of quality will be central to managing the risks associated with groundwater mining.

~~126.~~145. Prior to developments in the respective TBAs, a census of existing water users will be conducted. This approach will mitigate the risk of over-allocation of groundwater. This approach accepts the fact that groundwater resources are diminishing and overexploited in some parts of the region.

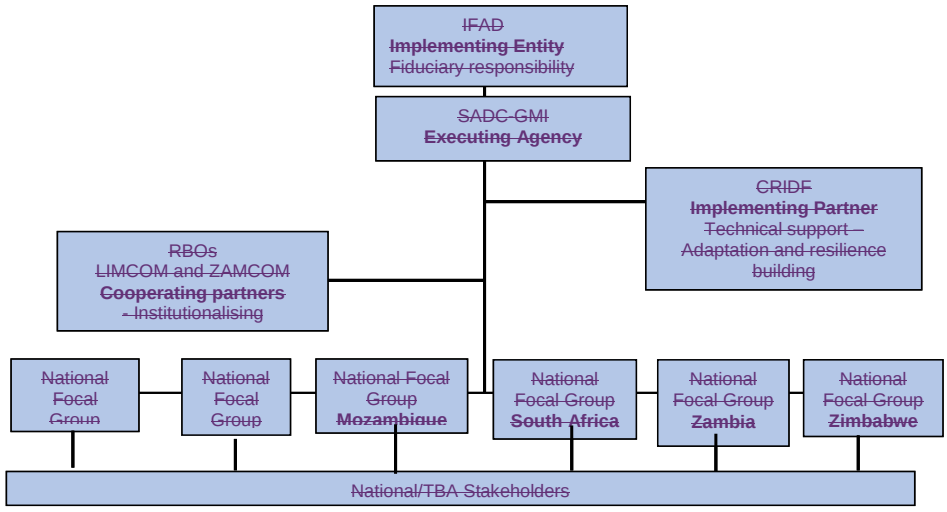
~~127.~~146. Economic, social and environmental benefits will be further identified and qualified at design stage and included in Environmental and Social Management Framework that will guide the project implementation. The implementing environmental authorities will ensure compliance with relevant standards and regulations. The ESMFs of the SADC-GMI will guide in managing the environmental and social impacts of infrastructure projects such as Managed Aquifer Recharge sites, agricultural plots, borehole drilling sites etc.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for programme implementation.

The project implementation arrangement will comprise IFAD as the Implementing Entity assuming fiduciary responsibility and implementation oversight. SADC-GMI will be the Executing Agency. CRIDF is an Implementing Partner tasked with providing Technical support on Adaptation and resilience building. The River Basin Organisations (RBOs) LIMCOM and ZAMCOM will have the role of Cooperating partners, with the role of Institutionalising Interventions. LIMCOM and ZAMCOM have acknowledged groundwater as their core responsibility. National Focal Groups in each of the Member States will serve the purpose of coordinating national to local level stakeholder input and participation. The Groundwater-National Focal Groups (NFG) bring together groundwater stakeholders across various sectors in the country to support sustainable groundwater resource management, development and use. Membership of the NFG represent relevant mandated government institutions (multiple levels), academic and research institutions, the private sector (including drilling companies and consulting firms), Non-Governmental Organisations (NGOs), community-based organisations, service suppliers and the main user sectors. The NFG structure ensures that all stakeholders are involved and reaches all levels of stakeholders. The proposed project organogram is shown below

ORGANOGRAM FOR IMPLEMENTATION



B. Demonstrate how the project / programme aligns with the Results Framework of the Adaptation Fund

~~128.~~147. The alignment of the project with the Adaptation Fund Results Framework is outlined below. Further analysis of the alignment will be done during the design phase of the project.

Project Objective(s)[15]	**Project Objective Indicator**	**Fund Outcome**	**Fund Outcome Indicator**	**Grant Amount (USD)**
Increase technical knowledge and understanding of transboundary groundwater resources to inform policy development and investment decision making	TBD	Improved policies and regulations that promote and enforce resilience measures	Climate change priorities are integrated into national development strategy	TBD
Develop strong and mutually agreed governance and cooperation frameworks, strategies and policies for sustainable use, management and protection of shared groundwater resources	TBD	Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses	2.1. Capacity of staff to respond to, and mitigate impacts of, climate-related events from targeted institutions increased	TBD
Develop information systems that provide robust, real time data that can be used for investment decision making	TBD	Support the development and diffusion of innovative adaptation practices, tools and technologies	Innovative adaptation practices are rolled out, scaled up, encouraged and/or accelerated at regional, national and/or subnational level.	TBD
Develop equitable, fair and climate resilient access to groundwater resources for smallholder farmers and agribusiness in local Resilience Hubs	TBD	Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level	3.2. Percentage of targeted population applying appropriate adaptation responses	TBD
Project Outcome(s)	**Project Outcome Indicator**	**Fund Output**	**Fund Output Indicator**	**Grant Amount (USD)**
Policy makers and country level institutions have robust, scientific and reliable data to enable decision making on transboundary groundwater management	TBD	Output 7: Improved integration of climate-resilience strategies into country development plans	7.2. No. of targeted development strategies with incorporated climate change priorities enforced	TBD
Smallholder farmers and agribusinesses are more resilient to climate change in the prioritised aquifers through the implementation of priority adaptation actions and infrastructure	TBD	Output 2.1: Strengthened capacity of national and sub-national centers and networks to respond rapidly to extreme weather events	2.1.2 No. of targeted institutions with increased capacity to minimize exposure to climate variability risks (by type, sector and scale)	TBD
Climate resilience is built for smallholder farmers and agribusinesses through climate smart practices	TBD	Output 8: Viable innovations are rolled out, scaled up, encouraged and/or accelerated.	8.1. No. of innovative adaptation practices, tools, technologies accelerated, scaled-up or replicated	TBD
Appropriate measures are in place for the management of water for communities to support climate resilient access to water and the ability to develop resilient agricultural livelihoods	TBD	Output 3.2: Strengthened capacity of national and subnational stakeholders and entities to capture and disseminate knowledge and learning	3.2.2 No. of tools, guidelines developed (thematic, sectoral, institutional) and shared with relevant stakeholders	TBD

[15] The AF utilized OECD/DAC terminology for its results framework. Project proponents may use different terminology but the overall principle should still apply

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. Record of endorsement on behalf of the government[16]

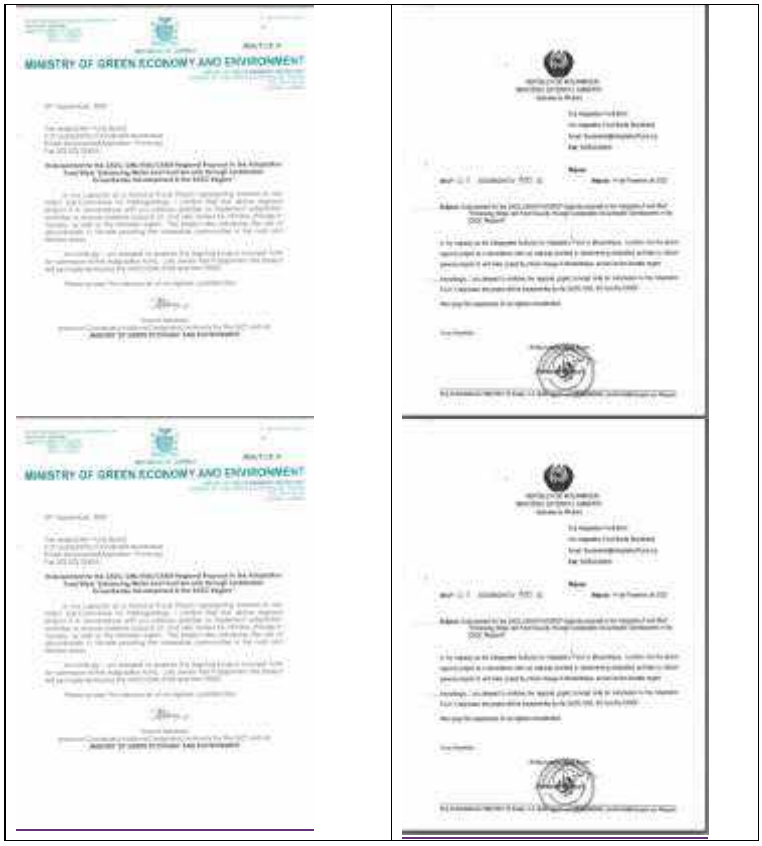
Zambia: Mr Francis Mpampi, National Coordinator-National Designated Authority for GCF and AF Ministry of Green Economy and Environment	Date: 27 September 2022
Mozambique: Ms. Emilia Dique Fumo Permanent Secretary Ministry of Land and Environment	Date: 14 February 2022
Botswana: Mr. Balisi Gopolang Senior Climatologist Department of Meteorological Services Ministry of Environment, Natural Resources conservation and Tourism	Date: 01 April 2022
Zimbabwe Mr. Washington Zhakata Director, Climate Change Management Department, Adaptation Fund Focal point Ministry of Environment, Tourism and Hospitality Industry	Date: 07 February 2022
Malawi Mr. Peter K. Simbani Designated Authority for the Adaptation Fund in Malawi Ministry of Industry	Date: 30 September 2022
South Africa Ms. Nomfundo Tshabalala Director General Department of Forestry, Fisheries and the Environment	Date: 06 October 2022

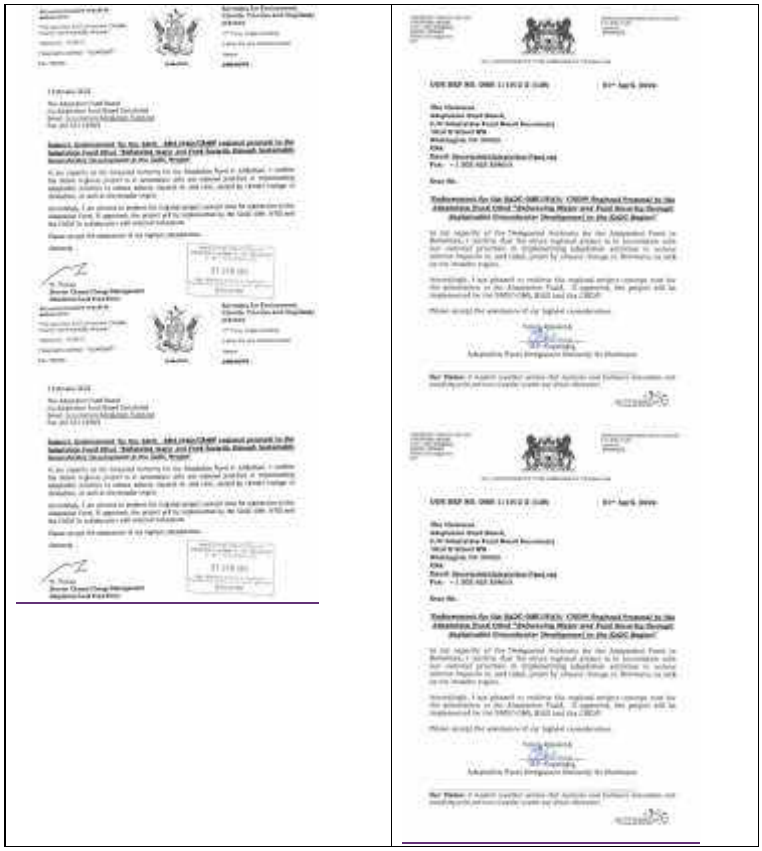
[6] Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

B. Implementing Entity certification

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans of Botswana, Malawi, Mozambique, South Africa, Zambia and Zimbabwe and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
Implementing Entity Coordinator: **Mr Tom Mwangi Anyonge** *Director, a.i.,* *Environment, Climate, Gender and Social Inclusion Division (ECG), IFAD*	
Date*:* 9/01/2023	email: ecgmailbox@ifad.org
Project Contact Person: **Ms Paxina Chileshe** *Regional Climate and Environment Specialist, East and Southern Africa* IFAD, Tel. and email: +254 207621035 - p.chileshe@ifad.org	
IFAD HQ focal point: **Ms Janie Rioux** *Senior Technical Specialist (Climate Change), ECG Division, IFAD* Email: j.rioux@ifad.org	

Annex 1. Letters of Endorsement





Project Formulation Grant (PFG)

Submission Date: 9 January 2023

Adaptation Fund Project ID: AF00000265

Country/ies: Botswana, Malawi, Mozambique, South Africa, Zambia and Zimbabwe
Title of Project/Programme: Enhancing Water and Food Security through Sustainable Groundwater Development in the SADC Region
Type of IE (NIE/MIE): Multilateral implementing entity
Implementing Entity: International Fund for Agricultural Development (IFAD)
Executing Entity/ies: SADC Groundwater Management Institute

A. Project Preparation Timeframe

Start date of PFG	Concept Note approval date
Completion date of PFG	10 months after Concept Note approval date

B. Proposed Project Preparation Activities ($)

Describe the PFG activities and justifications:

List of Proposed Project Preparation Activities	Output of the PFG Activities	USD Amount
Environment Impact Studies	Development of an ESCMF detailing the mitigation actions and its M&E system Environmental Impact assessments	10 000
Stakeholder Consultation Plan including Gender Analysis	Preliminary baseline assessment and additional stakeholder mapping and consultations	102 000
Workshops	National and regional workshops with stakeholders and local communities	120 000
Design of full proposal	A full funding proposal document for submission to AF	10 000
Hire consultants	Costs to cover support from technical specialists and travel	8 000
Total Project Formulation Grant		50 000

C. Implementing Entity

This request has been prepared in accordance with the Adaptation Fund Board's procedures and meets the Adaptation Fund's criteria for project identification and formulation

Implementing Entity Coordinator, IE Name	Signature	Date (Month, day, year)	Project Contact person	Telephone	Email Address
Mr Tom Mwangi Anyonge Director a.i Environment, Climate, Gender and Social Inclusion Division IFAD			Ms Janie Rioux Ms Paxina Chileshe	+254 793 484 367	j.rioux@ifad.org p.chileshe@ifad.org

Annex 3. Stakeholder Consultation Report for national entities and transboundary river basin organizations

Country	Date	Report
Botswana	01.12.2021	IFAD_AF_Concept Note Stakeholder Consultation Report_- Botswana.pdf
Malawi	01.12.2021	IFAD_AF_Concept Note__Stakeholder Consultation Report_- Malawi.pdf
Mozambique	01.12.2021	IFAD_AF_Concept Note_ Stakeholder Consultation Report_- Mozambique.pdf

South Africa	02.12.2021	IFAD_AF_Concept Note _Stakeholder Consultation Report_- South Africa.pdf
Zambia	02.12.2021	IFAD_AF_Concept Note_Stakeholder Consultation Report_- Zambia.pdf
Zimbabwe	01.12.2021	IFAD_AF_Concept Note_Stakeholder Consultation Report_- Zimbabwe.pdf
LIMCOM	01.12.2021	IFAD_AF_Concept Note_ Stakeholder Consultation Report_- LIMCOM.pdf
ZAMCOM	02.12.2021	IFAD_AF_Concept Note_Stakeholder Consultation Report_- ZAMCOM.pdf