



ADAPTATION FUND

PROGRAMME ON INNOVATION: LARGE GRANTS PROJECTS

REQUEST FOR PROJECT FUNDING FROM THE ADAPTATION FUND

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project must be fully prepared when the request is submitted.

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ADAPTATION FUND

SINGLE COUNTRY/ REGIONAL INNOVATION PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT/PROGRAMME INFORMATION

Title of Project/Programme:	Enhancing resilience to flood and drought through a unique combination of innovative climate adaptation tools, technologies, and practices in Burundi
Country/ Countries:	Burundi
Thematic Focal Area ¹ :	Disaster risk reduction and Food security
Type of Implementing Entity:	Regional Implementing Entity
Implementing Entity:	UN Environment Programme (UNEP)
Executing Entities:	Ministère de l’Environnement, de l’Agriculture et de l’Elevage
Amount of Financing Requested:	5,001,480 US Dollars

¹ Thematic areas are: Agriculture, Coastal Zone Management, Disaster risk reduction, Food security, Forests, Human health, Innovative climate finance , Marine and Fisheries, Nature-based solutions and ecosystem based adaptation, Protection and enhancement of cultural heritage, Social innovation, Rural development, Urban adaptation, Water management, Wildfire Management.

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1. Project / Programme Background and Context

1.1 Project Context

1. Burundi is a small, landlocked country with abundant natural resources, especially minerals and hydropower potential, but years of conflict have severely damaged its economic structure and contributed to widespread poverty^{2 3}.
2. The country and its people are strongly dependent on climate sensitive economic sectors such as agriculture (mainly rain-fed) and animal husbandry. Agriculture contributes 39.2% to the country's GDP, occupying almost 94% of the working population⁴. Agriculture exports (coffee, tea, cotton) provide all but a small percentage of export revenues⁵.
3. In Burundi, women make up 56% of the agricultural workforce. Although rural women and men may play complementary roles in farming activities, women tend to play a greater role in natural resource management and ensuring nutrition in the household. Responsibility for climate change adaptation is likely to fall on their shoulders, including finding alternative ways to feed and provide water for their families⁶.
4. Burundi's annual population growth, 3.1%⁷, is among the highest in the world. The country's population is projected to more than double by 2050. With an average density of more than 400 people per square kilometre, Burundi is the second most densely populated country in Sub-Saharan Africa. Population densities vary across the country⁸. The eastern part of the country has the lowest density, while population densities of 500–2,000 inhabitants per square kilometre occur in the capital, Bujumbura, and the main cities, such as Ngozi and Kayanza in the north, Gitega in the midlands, and Rumonge in the south⁹.
5. Ranking in the bottom five countries of the Human Development Index, poverty is widespread, with 90-95% of the population living on less than USD 2 per day, particularly in rural areas. Burundi is considered the world's hungriest country with almost 40% of its country in need of food¹⁰. When coupled with intermittent droughts, food shortages deepen and urban migration increases. Although this situation is present throughout Burundi, it is profound in Cibitoke, Bubanza and Bujumbura Rural provinces¹¹.
6. Burundi has been characterised as one of the countries in the region that are 'less actively engaged' in climate change adaptation. This is the outcome of national priorities and national

² NABC (2013): Burundi Business Fact Sheet

³ World Bank Climate Change Knowledge Portal, Burundi http://sdwebx.worldbank.org/climateportal/countryprofile/home.cfm?page=country_profile&CCode=BDI

⁴ CIA World Factbook (2015). Available via <https://www.cia.gov/library/publications/the-world-factbook/geos/by.html>

⁵ Burundi Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

⁶ Brody et al., 2008, p. 4, in Nabalamba, A., Mubila, M., Alexander, P. (2011): Climate Change, Gender and Development in Africa. African Development Bank

⁷ World Bank Data – Population growth (2016) <http://data.worldbank.org/indicator/SP.POP.GROW/countries>

⁸ Burundi Ministry of Finance, 2007 in Baramburiye et al. (2013)

⁹ Baramburiye et al. (2013)

¹⁰ World Population Review – Burundi. <http://worldpopulationreview.com/countries/burundi-population/>

¹¹ These provinces are the targeted provinces of Netherlands bilateral food security programme. Embassy of the Kingdom of the Netherlands (EKN) 2013. Multiannual Strategic Plan (2014-2017).

capacities¹² and more recently the political crisis which has also resulted in a decline of opportunities for financial and technical support. Burundi has prepared national strategies and policies for climate change and participated in the UNFCCC conferences and agreements.

1.2 Impact Climate Change

7. Globally, Burundi has the lowest per capita GHG emissions, ranking 188 out of 188 countries and contributing only 0.01% to global emissions. However, it is highly vulnerable to global climate change. Burundi ranks 165 out of 180 countries in the ND-GAIN index¹³ (2022) with regards to vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. Burundi ranks 160 out of 181 countries in terms of vulnerability i.e. its exposure, sensitivity and ability to adapt to the negative impact of climate change. The country ranks 173 out 192 regarding readiness i.e. its ability to leverage investments and convert them to adaptation actions. These rankings suggest that Burundi is extremely vulnerable and not ready to combat climate change effects.
8. Natural hazards have a destructive impact on the socioeconomic wellbeing of Burundi and its population. Figure 1 reflects the types and distribution of the types of natural hazards the country must deal with.

Natural Hazard Occurrence for 1980 – 2020

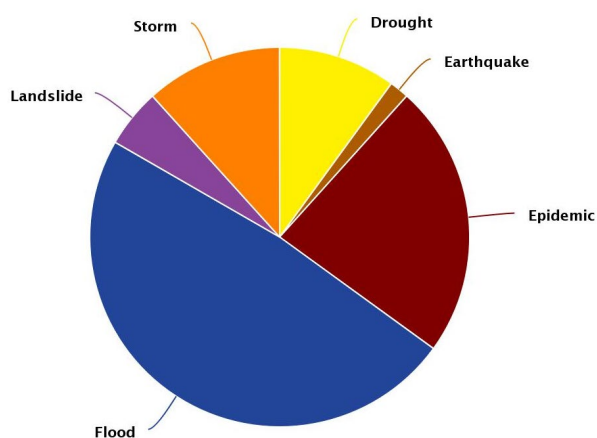


Figure 1: Average Annual Natural Hazard Occurrence for 1980 – 2020¹⁴

¹² Hove, H.; Echeverría, D.; Parry, J.E. (2011): Review of Current and Planned Adaptation Action: East Africa. Adaptation Partnership / International Institute for Sustainable Development. https://www.iisd.org/pdf/2011/East_Africa_Adaptation_Action.pdf

¹³ The ND-GAIN index summarizes a country's vulnerability to climate change and other global challenges in combination with readiness to improve resilience. <https://gain.nd.edu/our-work/country-index/rankings/>

¹⁴ <https://climateknowledgeportal.worldbank.org/country/burundi/vulnerability>

9. Burundi has a history of extreme events that are considered climate related. Historically, various zones experienced frequent famines and destructive hailstorms. The regions struck hardest by such events are (see Figure 2 which is Adapted from FEWS NET and USAID (2009): Livelihoods zoning “plus” activity in Burundi):

- BI01 (Buragane): droughts and erosion¹⁵;
- BI03 (eastern depressions) north, BI04 (northern depressions) and BI09 (dry eastern plateaus) north:
 - frequent and severe droughts and famines (several per decade) – in BI04 combined with regression of lake levels;
 - since 1999, frequent violent rains, causing erosion, combined with thunder and lightning.
- BI07 (Imbo plains) north:
 - frequent excessive rains, causing floods and occasionally significant increases in the water level of Lake Tanganyika;
 - frequent rainfall shortages.

Zones most at risk due to climate change

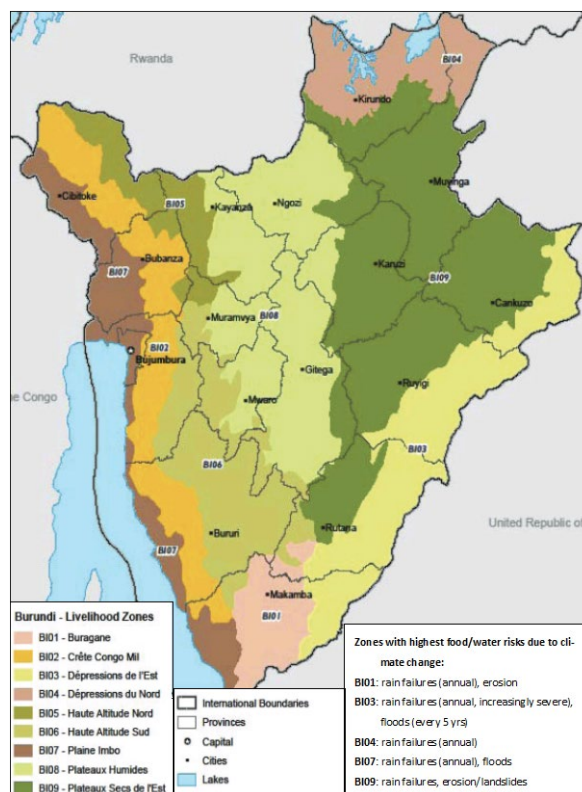


Figure 2: Zones most at risk due to climate change

10. Projections for future changes in temperature due to climate change estimate an increase of 0.4°C per decade¹⁶ and a 1.9°C increase by 2050¹⁷. Projections suggest the following¹⁸:

- A reduction in precipitation is expected for May (end of rainy season) and October (beginning of rainy season).
- Most models project there will be a slight increase in days with ‘heavy’ rain by 2100.
- An increase of drought is expected in the northern part of the country that will cause a decrease in water levels in the northern lakes.
- Floods are expected to increase in frequency and magnitude in the low-lying areas (e.g. Imbo floodplain).
- Models project an increase in the number of ‘hot’ days per year for 2046-2065 and 2081-2100 under the low and high emissions scenarios.
- Droughts are expected to become more intense and more frequent, occurring between 40 and 60% of the time.

¹⁵ FEWS NET and USAID (2009)

¹⁶ Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

¹⁷ Climate Change Knowledge Portal. Available via: http://sdwebx.worldbank.org/climateportal/countryprofile/home.cfm?page=country_profile&CCCode=BDI&ThisTab=ClimateFuture

¹⁸ World Bank Climate Change Knowledge Portal, Burundi. http://sdwebx.worldbank.org/climateportal/countryprofile/home.cfm?page=country_profile&CCCode=BDI

11. Under current climate change trends there will be a significant impact on some of the principal food and commercial crops in Burundi. The main staple crops are bananas, cassava, sweet potatoes, and beans. Maize (a secondary staple crop), beans and sweet potato yields are expected to decrease gradually, with maize yield decreases of 5-25% predicted for the next decades¹⁹. Rising temperatures and erratic or lower rainfall will have a negative impact on Burundi's primary exports of coffee and tea, which account for 90% of foreign exchange earnings²⁰. Extreme floods and droughts are estimated to result in a reduction of long-term growth by 2.4% of GDP per year²¹.

1.3 Programme Area

12. The programme will be implemented at one or multiple sites within the Imbo Basin across the Cibitoke, Bubanza and Bujumbura Rural and Bujumbura Mairie Provinces (see figure 3). During the feasibility study, different sites within these four provinces shall be assessed to ultimately select one or multiple sites to implement the adaptation measures. The number and size of project sites depend on the available budget. These four provinces have been selected considering that these are most vulnerable and prone to flooding and drought based on the following criteria:

- In terms of the environmental conditions, the sites experience high rainfall variability with increasing frequency and intensity of flood and drought occurrences and high environmental degradation (focusing on vegetation and soil degradation as well as degradation and deterioration of water resources such as streams and rivers).
- Communities inhabiting such sites are also food insecure characterized by recurrent famine and a shortage of food. There is high dependence on the rain-fed agriculture especially high dependence of farmers and pastoralists on crop and livestock farming.
- Socially, there are many vulnerable members among the smallholder farmers and pastoralists especially women, children, youth, disabled and elderly by gender. Low-income levels of the population/high poverty levels in such sites therein are known and reported.
- Economically, smallholder farmers and pastoralists have limited options in terms of the potential alternative sources of livelihoods and income.

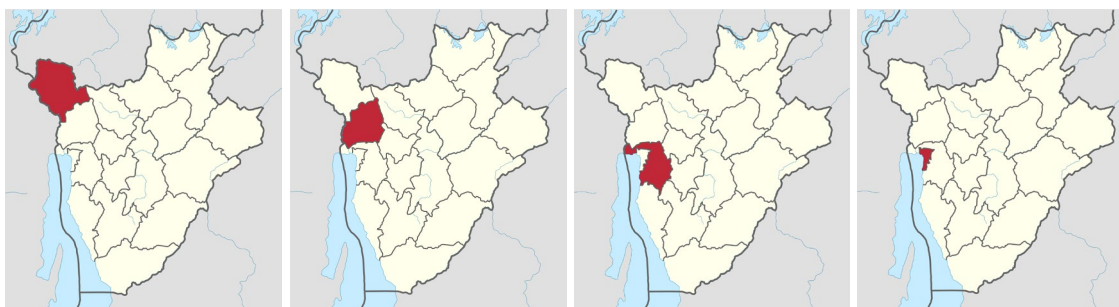


Figure 3: Cibitoke, Bubanza, Bujumbura Rural and Bujumbura Mairie Province

¹⁹ Baramburiye et al. (2013)

²⁰ Ross, P (2015) Climate Change Effects On Coffee Production: How Hotter Weather Is Killing The Global Arabica Bean Market <http://www.ibtimes.com/climate-change-effects-coffee-production-how-hotter-weather-killing-global-arabica-1905151>

²¹ DFID (2011): The economic impacts of climate change in Burundi. <http://weadapt.org/knowledge-base/economics-of-adaptation/economics-of-adaptation-burundi>

Cibitoke Province. Cibitoke Province is one of the 18 provinces of Republic of Burundi with a population of 491,000 people. Cibitoke Province has an elevation of 1,433 metres and is situated nearby to Nyamuhunba, and northeast of Rubura. The exact geographical coordinates: Latitude in decimal degrees -2.88333, Latitude in degrees, minutes, and seconds 2° 53' 60" South, Longitude in decimal degrees 29.25 and Longitude in degrees, minutes, and seconds 29° 15' East.

Bubanza Province. Bubanza is one of the 18 provinces of Burundi with a population of 354,000 people. Bubanza Province has an elevation of 909 metres and is situated east of Gahongore, and northeast of Cona. The exact geographical coordinates are: Latitude in decimal degrees -3.11667, Latitude in degrees, minutes, and seconds 3° 7' 0" South, Longitude in decimal degrees 29.4 and Longitude in degrees, minutes, and seconds 29° 24' East.

Bujumbura Rural Province. Bujumbura Rural Province is one of the 18 provinces of Burundi with a population of 556,000 people. The province surrounds the former national capital Bujumbura. The province is 1792 m above sea-level. The provincial capital is Isale. The exact geographical coordinates are: Latitude in decimal degrees -3.4627, Latitude in degrees, minutes, and seconds 3° 28' 46" South, Longitude in decimal degrees 29.46259 and Longitude in degrees, minutes, and seconds 29° 28' 45" East.

Bujumbura Mairie Province. Bujumbura Mairie Province is one of the eighteen provinces of Burundi with a population of 800,000 people. It consists entirely of the city of Bujumbura, Burundi's former capital. The province is 780 m above sea-level. Exact geographical coordinates: Latitude in decimal degrees -3.3802, Latitude in degrees, minutes, and seconds 3° 23' 49" South, Longitude in decimal degrees 29.3547 and Longitude in degrees, minutes, and seconds 29° 21' 17" East.

13. The programme area is rather broad at this stage. The programme shall identify the exact location(s) of the implementation and include this in the full proposal. Insight in the exact locations ensures that the programme can adhere to the Environmental and Social Policy (ESP) and the Gender Policy (GP) of the Adaptation Fund. The aim is to analyse environmental and social risks for each programme activity and avoid any unidentified sub-projects (USPs)²² when submitting the full proposal.

1.4 Upscaling Pilot Project

14. A pilot project was implemented in 2022 that aimed to demonstrate the effectiveness of a water-filled mobile flood barrier to enhance resilience to flood and drought risk. This project was completed successfully and to the satisfaction of local stakeholders, so much so that the President of Burundi presented this during COP27 in Egypt. Due to its success, it was decided to scale up this technology in Burundi to increase the realization of flood and drought Adaptation Benefits (ABs). It was furthermore decided to expand not only the regional scope but also the scope of the adaptation measures to mitigate flood and drought risks. An initial unique portfolio of innovative solutions has been designed centred around the water-filled mobile flood barrier.

²² Guidance on USPs can be found here: <https://www.adaptation-fund.org/wp-content/uploads/2022/10/PPRC.30.54-Updated-guidance-on-USPs-with-Annex.pdf>

15. The proposed programme builds upon the knowledge and experience from the pilot project by engaging many of the same stakeholders such as: (i) ministries, (ii) communities, (iii) farmers, (iv) hydrologists, (v) a financial institution, (vi) flood and drought consultants, and (vii) a local NGO. Lessons learned from the pilot project shall be taken into consideration with the proposed programme. The key lessons learned are:
- (i) The country lacks in a data rich environment with reliable weather-related to support flood and drought risk analyses. The proposed programme therefore must enrich available data.
 - (ii) Import duties and taxes are excessive (150%), which could seriously impact the project budget. The proposed programme shall apply for a tax exemption at an early stage.
 - (iii) One of the most important reasons that the pilot project was successful, was due to the collaboration with a highly professional local partner. The same partner shall be involved in the proposed programme.
16. The pilot project was implemented at the Mpanda Commune which lies in the Bubanza Province. The members involved in the programme are therefore already familiar with flood and drought risks at a site within the Imbo Basin.

2. Programme Objectives

17. The overall goal of the programme is to increase the resilience of people and institutions in Burundi to (climate change-induced) flood and drought events through the implementation of a unique combination of innovative adaptation technologies supported by information technology.
18. The project aims to consolidate synergies and adopt innovative and resilient flood drought management actions from selected regions in Burundi. The overall goal of the project translates into the following key objectives:
- (i) Implementation of information framework and services, to garner insight in weather-related data to improve analyses and decision making with regards to flood and drought events.
 - (ii) Implementation of innovative adaptation tools, technologies, and practices to prevent flooding and enhance resilience to drought by harnessing water for irrigation purposes.
 - (iii) Strengthening and improving the capacity of key stakeholders in flood and drought risk management at regional, national, and local levels to undertake innovative adaptation actions that reinforce their resilience to flood and drought events.
 - (iv) Support existing channels and networks or develop new ones for flood and drought information generation and dissemination at national and sub-national level.

3. Programme Components and Financing

Table 1: Budget summary

Programme Components	Expected Outcomes	Expected Outputs	Countries	Amount (US\$)		
1. Development and enhancement of flood and drought information technology and services.	1.1: Increased usage of effective information technology by stakeholders.	1.1.1: Efficient and effective flood and drought information technology and services implemented.	Burundi	250,000		
		1.1.2: Collected and stored data to support flood and drought information services.	Burundi	100,000		
		1.1.3: Institutional linkages for information established.	Burundi	40,000		
		1.1.4: Feedback mechanism for information services developed.	Burundi	40,000		
		1.1.5: Emergency plan for flood and drought management is put in place.	Burundi	40,000		
2. Implementing innovative flood and drought adaptation tools, technologies, and practices.	2.1: Increased uptake and usage of innovative flood adaptation tools, technologies and practices.	2.1.1: Flood risks analysed, and flood adaptation tools, technologies and practices designed.	Burundi	130,000		
		2.1.2: Enabling environment for flood adaptation tools, technologies and practices created.	Burundi	80,000		
		2.1.3: Innovative water-filled mobile flood prevention structures constructed.	Burundi	1,650,000		
		2.1.4: Adaptive flood prevention practices promoted.	Burundi	50,000		
	2.2: Increased uptake and usage of innovative drought adaptation tools, technologies and practices.	2.2.1: Drought risks analysed, and drought adaptation tools, technologies and practices designed.	Burundi	100,000		
		2.2.2: Enabling environment for drought adaptation tools, technologies and practices created.	Burundi	50,000		
		2.2.3: Innovative water harnessing and irrigation structures established.	Burundi	1,100,000		
		2.2.4: Adaptive drought prevention practices promoted.	Burundi	60,000		
		3. Strengthening the capacity of stakeholders	3.1: Flood and drought resilience	3.1.1: Flood and drought management plans (FDMPs)	Burundi	100,000

to manage (climate change-induced) flood and drought risks.	of key stakeholders at national and sub-national level strengthened.	integrating climate change aspects and adaptation actions are developed.		
		3.1.2: Adaptive capacity of institutions, farmers, and pastoralists in flood and drought management is improved.	Burundi	110,000
	3.2: Partnerships for flood and drought management at national and sub-national level strengthened.	3.2.1: New/existing national and sub-national arrangements/networks for flood and drought management supported.	Burundi	100,000
4. Enhancing knowledge management, awareness creation and information sharing on flood and drought risks.	4.1: Strengthened awareness and ownership of flood and drought adaptation and climate risk reduction processes at local level.	4.1.1: Good practices and lessons on flood and drought management documented and disseminated.	Burundi	110,000
		4.1.2: Flood and drought information management strengthened.	Burundi	100,000
6. Programme Execution cost (10%)				421,000
7. Total Programme Cost				4,631,000
8. Programme Cycle Management Fee charged by the Implementing Entity (7%) + UN SC RC (1%)				370,480
Amount of Financing Requested				5,001,480

4. Projected Calendar

Table 2: Programme calendar

Milestones	Expected Dates
Start of Programme Implementation	January 2024
Mid-term Review (if planned)	June 2025
Programme Closing	January 2027
Terminal Evaluation	June 2027

PART II: PROGRAMME JUSTIFICATION

A. Programme Components

COMPONENT	Development and enhancement of flood and drought information technology and services.
1. 	

19. Effective flood and drought risk management decisions rely on accurate information, which requires reliable and timely information technology (soft- and hardware) and weather-related data. Information technology and data are the most important assets that people, and institutions can access to analyse and implement flood and drought resilient actions. People and institutions in Burundi are currently constrained in accessing flood and drought information, which limits their ability to respond or deal with flood and drought risks effectively. The lack of effective resilient measures or an adequate response to flood and drought events limit the ability to prevent: (i) crop failures, (ii) pasture losses, (iii) the death of livestock, (iv) soil degradation, (v) conflicts, (vi) migration, and (vii) food and water insecurity.
20. The first component of the programme will focus on implementing and upgrading flood and drought information technology and weather-related data. This component conducts baseline studies and assessments to understand the status of the existing information technology and data to manage flood and drought risks. The programme shall recommend improvements of the information technology to support flood and drought interventions. This component furthermore establishes institutional linkages to share flood and drought information. Flood and drought related information shall be made accessible to relevant people and institutions.
21. The activities of the proposed programme facilitate people and institutions to generate and process flood and drought information to enhance knowledge on flood and drought risk management. The specific activities of this component are highlighted under outcomes 1.1 and 1.2 and outputs 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.2.1 and 1.2.2.

Outcome 1.1: Increased usage of effective information technology by stakeholders.

22. Concrete effective and efficient innovative information technology will be implemented by installing and upgrading (i) weather monitoring equipment, (ii) an information architecture and (iii) information services such as an Early Warning System (EWS) and a Flood Intelligence Service (FIS). Furthermore, weather-related data shall be collected and stored to analyse and response to flood and drought risks. The installed and upgraded information technology and services enable timely and accurate communication of flood and drought events as well designing effective flood and drought resilient tools, technologies, and practices.
23. The operation and maintenance of the information technology and data shall be standardised and centralised at regional and (inter)national level. There will be an alignment between people and institutions at national and subnational level. Information technology is supported by the selected supplier(s) with whom there will be service agreements. Capacity building and training

sessions will be organised to ensure stakeholders can operate and maintain information technology and benefit the most from information services.

Output 1.1.1: Efficient and effective flood and drought information technology and services implemented.

24. There are many areas within the Imbo Basin where people are impacted by flood and drought risks due to changing weather patterns caused by climate change. It is imperative that people living in these areas understand the risks and take preventive and repressive measures to mitigate flood and drought risks. People can take efficient and effective measures when they have access to timely and reliable information on flood and drought threats.

25. Through the proposed programme, information technology and supporting data will be implemented within the Imbo Basin, at specific project sites that shall be selected during the feasibility study. Beneficiaries such as community members, farmers, pastoralists shall have improved access to flood and drought information services such as an EWS (see Figure 4). This access to information allows stakeholders to effectively plan and respond to flood and drought events.

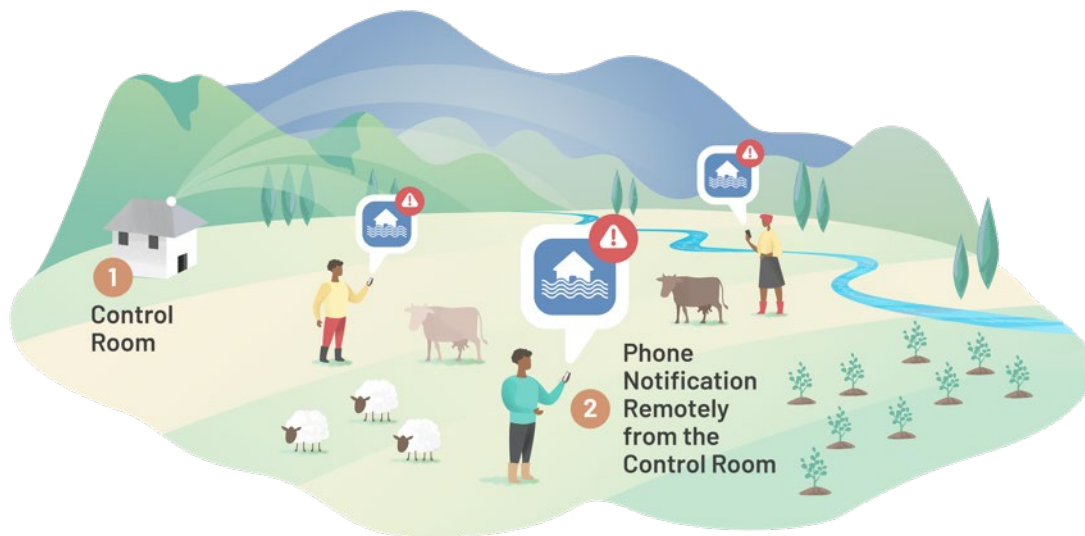


Figure 4: Early warning system will be implemented

Activities

- Activity 1.1.1.1: Perform gap analyses between current status of flood and drought information technology (soft- and hardware) with the desired information technology on national level and the target regions.
- Activity 1.1.1.2: Develop implementation plans to construct/upgrade the flood and drought information technology.
- Activity 1.1.1.3: Develop/upgrade flood and drought information technology at national and regional levels.
- Activity 1.1.1.4: Setup/renovate flood and drought resilience centers including data warehousing.

- Activity 1.1.1.5: Support/equip project beneficiaries to access flood and drought information (e.g. apps, brochure, SMS, radio etc.).

Output 1.1.2: Collected and stored data to support flood and drought information services.

26. Accurate weather-related data is needed to develop reliable flood and drought information services. The proposed programme aims to collect as much reliable data as feasible to ensure that stakeholders have access to reliable flood and drought information. The proposed programme and the country will benefit from a data rich environment, which is currently lacking. After conducting a baseline study, a decision will be made on how to enrich available data through new means and sources. It is likely that Light Detection and Ranging (LiDAR) technology will be used to enrich existing available data. LiDAR data is used for Digital Elevation Models (DEMs) and land use maps. These data are highly valuable when analysing flood and drought risks and designing concrete adaptation measures. A data management system will be established to organise and store data in a data warehouse.

Activities

- Activity 1.1.2.1: Assess the availability of data to support flood and drought information services including FIS and EWS.
- Activity 1.1.2.2: Collect/enrich data to support flood and drought information services.
- Activity 1.1.2.3: Store data to support flood and drought information services and setup user access management.
- Activity 1.1.2.4: Conduct baseline study.

Output 1.1.3: Institutional linkages for information established.

27. Maintaining and operating information technology and disclosing information requires close collaboration between different departments at national and subnational level and with international suppliers. It is imperative that the roles and responsibilities are clear and agreed upon with regards to information management. The proposed programme follows a participatory approach when developing information technology and develops frameworks that clearly reflect processes including the different roles and responsibilities. Gatherings will be organised to create a paradigm shift to ensure information management is embedded in business-as-usual activities.

Activities

- Activity 1.1.3.1: Develop/review flood and drought information sharing frameworks at regional at national regional and local levels.
- Activity 1.1.3.2: Develop an implementation action plan to operationalize the frameworks.
- Activity 1.1.3.3: Hold meetings with institutions and other stakeholder groups for data sharing.
- Activity 1.1.3.4: Support national, regional, and local information sharing forums (including farmers and pastoralist associations).
- Activity 1.1.3.5: Support Incorporation of flood and drought information into planning and budgeting processes of Burundi.

Output 1.1.4: Feedback mechanism for information services developed.

28. The information technology requires continuous maintenance and enhancements to realise a certain level of quality of flood and drought information. A feedback mechanism ensures that experiences with the information technology is shared amongst stakeholders. In turn, this enables insight in the extent to which information technology meets expectations and whether improvements/changes are required. The feedback mechanism is essential to ensure active and reliable usage of flood and drought information.

Activities

- Activity 1.1.4.1: Support regular stakeholder flood and drought information feedback platforms for stakeholders such as farmers and pastoralists.
- Activity 1.1.4.2: Hold quarterly stakeholder meetings on flood and drought information utilization for national, regional, and local stakeholders.
- Activity 1.1.4.3: Conduct Knowledge, Attitude and Practices (KAP) surveys on flood and drought information.
- Activity 1.1.4.4: Develop periodic feedback user-friendly tools on accessing, utilizing, and reporting flood and drought information to mandated institutions.

Output 1.1.5: Emergency plan for flood and drought management is put in place.

29. Disseminating reliable flood and drought information enables effective preventive and repressive measures to reduce the risk of flood and drought damages. The information technology is therefore a trigger for follow-up actions such as the deployment of a mobile flood barrier. These follow-up actions are included in emergency plans including roles and responsibilities and process descriptions. Tools and materials can be provided to improve the dissemination of flood and drought threats such a flags or speakers.

Activities

- Activity 1.1.5.1: Develop an emergency response plan for flood and drought disasters at the national, regional, and local levels.
- Activity 1.1.5.2: Monitor the flood and drought information services, feedback mechanism and its contingency plan at regional/local level.
- Activity 1.1.5.3: Acquire tools and materials to disseminate warning messages to the populations (e.g., beacons, flags, sirens, signalling, speakers, telephone, local radios etc.).

COMPONENT
2. 
Implementing innovative flood and drought adaptation tools, technologies, and practices.

30. Institutions and other stakeholder groups in Burundi have limited access to effective flood and drought tools and technologies which prevents them from taking the necessary actions to prevent damages. The lack of effective flood and drought resilient tools and technologies have a devastating impact on the socio-economic and environmental wellbeing of the country and in particular the sites in scope of the proposed programme.

31. Component two aims to increase resilience of people and institutions by implementing a unique portfolio of innovative flood and drought adaptation tools, technologies, and practices centred around a water-filled mobile flood barrier. The aim is for the unique portfolio of adaptation measures to be a blueprint for future programmes to enhance resilience to flood and drought.



Figure 5: Flood and drought risks will be analyzed to design technologies

32. The activities for this component are highlighted below under outcomes 2.1 and 2.2 and outputs 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.2.1, 2.2.2, 2.2.3 and 2.2.4.

Outcome 2.1: Increased uptake and usage of innovative flood adaptation tools, technologies, and practices.

33. Concrete flood resilient tools, technologies and practices will be implemented at the selected locations to mitigate the risk of flooding. The portfolio of measures centre around an innovative water-filled mobile flood barrier, a technology that has been demonstrated successfully in Burundi in 2022 as part of a pilot project. The flood resilient measures that will be implemented are durable and meet local specific requirements to mitigate flood risk effectively for a long period. The proposed programme will promote the usage of the implemented tools and technologies to ensure a large uptake and a paradigm shift.

Output 2.1.1: Flood risks analysed, and flood adaptation tools, technologies and practices designed.

34. The design of the flood resilient measures, including the water-filled mobile flood barrier, is based on flood risk analyses. Hydrodynamic modelling software in combination with local expertise gives insight in the flood risks. A Flood Intelligence Service (FIS) gives insight in how best to manage flood risks and what the anticipated Adaptation Benefits (ABs) are from implementing the adaptation measures.

Activities

- Activity 2.1.1.1: Develop flood scenarios for multiple locations baseline versus benefit scenarios; the latter includes the deployment of a mobile flood barrier to prevent damages.
- Activity 2.1.1.2: Determine the anticipated adaptation benefits from deploying the mobile flood barrier for multiple flood scenarios and select the scenarios to determine the required mobile flood barrier structure.
- Activity 2.1.1.3: Undertake assessment on how to deploy the mobile flood barrier to redirect excess flood water to innovative water harvesting and storage infrastructure.
- Activity 2.1.1.4: Design appropriate mobile flood barrier technologies and supporting equipment/infrastructure to realise the anticipated adaptation benefits from the selected benefit scenarios including the redirecting of the excess flood water.

Output 2.1.2: Enabling environment for flood adaptation tools, technologies and practices created.

35. The environment must be suitable to implement flood adaptation tools and technologies such as the water-filled flood barrier. The areas at the selected sites must be such that the flood barrier can effectively be deployed. For example, the ground might need to be levelled or debris has to be removed to be able to deploy the flood barrier. Furthermore, the proposed programme shall assess how flood resilient measures impact/benefit stakeholders such as insurance companies and buyers of crops and livestock products. These stakeholders can support in the design and implementation the flood resilient measures.

Activities

- Activity 2.1.2.1: Make the area/landscape suitable to ensure accessibility to the location of deployment and suitability to deploy the flood barrier e.g. by levelling the ground surface.
- Activity 2.1.2.2: Introduce and promote the mobile flood barrier to insurance companies and explore insurance products to address residual losses to climate risks. This technology will be useful to connect the potential beneficiaries to providers of the risk insurance solutions.
- Activity 2.1.2.3: Conduct flood risk assessments on the agriculture value chain.

Output 2.1.3: Innovative water-filled mobile flood prevention structures constructed.

36. The portfolio of adaptation measures in the proposed programme centre around the water-filled mobile flood barrier. Flood risk analyses using hydrodynamic modelling software provide insight in the characteristic of the flood events and how the mobile flood barrier can prevent damages. These analyses will be used to determine the dimensions of the flood barrier. Once the flood risks have been analysed, the mobile flood barrier will be constructed and shipped to the selected sites. A storage facility and transportation means will be available to store and deploy the flood barrier to mitigate flood risks effectively. The water-filled flood barrier will be deployed either when a threat of flooding has been detected or for a longer period of time e.g. during the entire flood season (see Figure 6).



Figure 6: Innovative mobile flood barrier will be implemented

Activities

- Activity 2.1.3.1: Construct appropriate, innovative mobile flood barriers and supporting equipment such as (solar powered) pumps and hoses.
- Activity 2.1.3.2: Construct storage facilities to store the mobile flood barrier.
- Activity 2.1.3.3: Ensure availability of appropriate means of transportation from the storage facility to the location of deployment such as trolleys or cars.
- Activity 2.1.3.4: Undertake assessment of impact climate change on erosion at the selected areas and to what extent the mobile flood barrier technology can strengthen resilience to erosion.

Output 2.1.4: Adaptive flood prevention practices promoted.

37. The flood resilient technologies are implemented in combination with flood resilient practices. The combination of effective technologies with practices enables effective mitigation of flood risks. Flood adaptation practices include selecting the right type of crops and land for food production. Practices also pertain to taking the necessary actions to prevent damages caused by flooding e.g. by seeking shelter in case of a threat of flooding.

Activities

- Activity 2.1.4.1: Support selection and introduction of crops that are least impacted by floods.
- Activity 2.1.4.2: Promote land use changes to limit the impact of floods.
- Activity 2.1.4.3: Support selection of geographical area to grow crops or for livestock production to limit the impact of floods.
- Activity 2.1.4.4: Promote response practices in case of a flood warning (e.g. seeking shelter, protecting people and assets, recovery planning).

Outcome 2.2: Increased uptake and usage of concrete and innovative drought adaptation actions.

38. Concrete drought resilient tools, technologies and practices will be implemented at the selected locations to mitigate the risk of drought. The portfolio of measures centre around an innovative water-filled mobile flood barrier. The same technology that is used to mitigate flood risk will be used to mitigate drought risk. The mobile flood barrier will be used to harness flood-/rainwater in the barrier and in man-made lakes. The drought resilient measures are durable and meet local specific requirements to mitigate drought risk effectively for a long period. The drought resilient tools and technologies are implemented in combination with drought resilient practices to create a paradigm shift.

Output 2.2.1: Drought risks analysed, and drought adaptation tools, technologies and practices designed.

39. The design of the drought resilient measures is based on drought risk analyses. Hydrodynamic modelling analyses in combination with local expertise give insight in the drought risks and how to mitigate these risks effectively. The design of the drought resilient measures will be included in the drought risk management plans.

Activities

- Activity 2.2.1.1: Develop drought scenarios for multiple locations baseline versus benefit scenarios; the latter includes usage of excess flood water stored in innovative water harvesting and storage infrastructure.
- Activity 2.2.1.2: Determine the anticipated adaptation benefits from drought adaptation intervention technologies for multiple drought scenarios and select the scenarios to determine required adaptation measures and technologies.
- Activity 2.2.1.3: Undertake assessment on water utilization/potential/availability and develop water management plans in project sites.
- Activity 2.2.1.4: Design drought adaptation measures and technologies including water harvesting facility (e.g. man-made lake or water tower), water treatment system, irrigation system.

Output 2.2.2: Enabling environment for drought adaptation tools, technologies and practices created.

40. The environment must be suitable to implement drought adaptation tools and technologies such as a water harvesting infrastructure. The areas at the selected sites must be such that the drought resilient measures can effectively be deployed. Furthermore, the proposed programme shall assess how drought resilient measures impact/benefit stakeholders such as farmers and buyers of crops and livestock products. These stakeholders can support in the design and implementation the drought resilient measures.

Activities

- Activity 2.2.2.1: Introduce and explore (Index-based) weather insurance in partnership with insurance companies. The project will mobilize partners to support Burundi to enhance knowledge and capacity on innovative risk insurance.

- Activity 2.2.2.2: Facilitate farmer and pastoralists associations/cooperatives and other stakeholder groups to generate analyze and share market information.
- Activity 2.2.2.3: Conduct drought risk assessments on the agriculture value chain.
- Activity 2.2.2.4: Create linkages between farmer and pastoralists associations/cooperatives at regional, national and sub-national levels to enable sharing of market information.

Output 2.2.3: Innovative water harnessing, and irrigation structures established.

41. Drought risks in many regions in the Imbo Basin overshadow flood risks. The programme aims to tackle both type of risks using the same innovative technology being a water-filled mobile flood barrier. The water stored in the flood barrier will be used to irrigate land during dry season. In addition, the water-filled mobile flood barrier will be deployed upstream to harness water during a rain or flood event (see Figure 7). The harnessed water will be utilized to improve water security in times of drought.



Figure 7: Water-filled flood barrier will serve as a water harvesting infrastructure

42. The programme shall implement a solar pumping and irrigation systems to utilize harnessed water to irrigate crops in times of drought. The irrigation system will increase crops production and therewith food security throughout the region (see Figure 8).

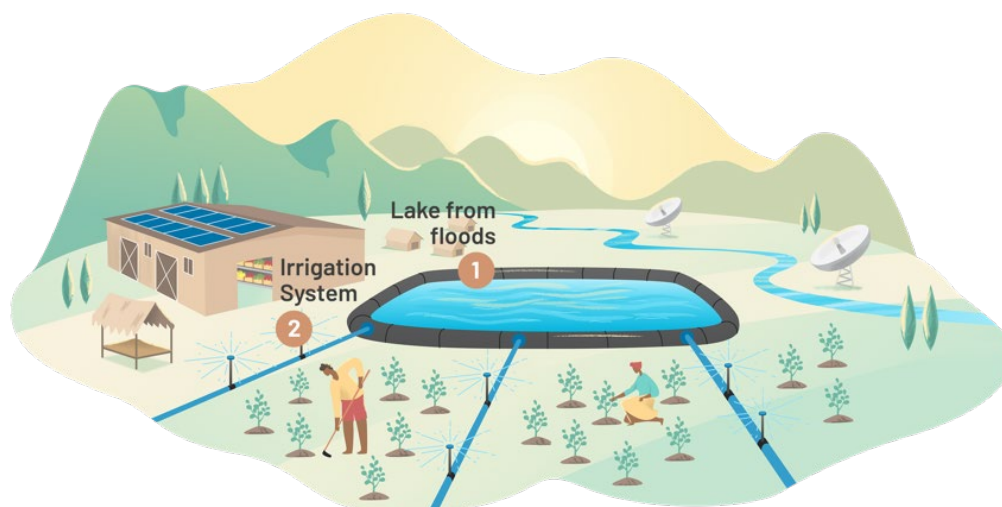


Figure 8: A solar pumping and irrigation system

Activities

- Activity 2.2.3.1: Construct appropriate, innovative water harvesting and storage infrastructure (e.g. man-made lake with EPDM layer, water tower, EPDM storage units). Measures/technologies will also be implemented to prevent evaporation of water when it's stored.
- Activity 2.2.3.2: Construct irrigation and water delivery systems (e.g. gravity flow scheme, micro-irrigation systems, check dams, drip irrigation, borehole irrigation, and solar powered irrigation systems). Furthermore, perform feasibility study to implement water delivery system for long distances e.g. by using pipe lines.
- Activity 2.2.3.3: Construct water treatment process/system to sustain or improve the quality of the stored water to reuse it for irrigation purposes, for livestock or even for human consumption.
- Activity 2.2.3.4: Promote appropriate water and soil conservation measures (e.g. minimal water usage for crops production, soil fertility management).
- Activity 2.2.3.5: Construct a solar power powered cold storage to store crops for a longer period to enhance food security during dry season.

Output 2.2.4: Adaptive drought prevention practices promoted.

43. The drought resilient technologies will be implemented in combination with drought resilient practices. These practices relate to agricultural activities to grow crops efficiently e.g., by selecting crops that don't use a significant amount of water. Mitigating drought risks through technologies and practices will result in enhanced food and water security. To further support food security, the proposed programme will install a solar powered cold storage facility to preserve crops and prevent these from getting spoiled (see Figure 9). Such a cold storage unit ensures availability of food throughout the year even when it's offseason. Farmers can increase their production to increase earnings and therewith improve their livelihoods.

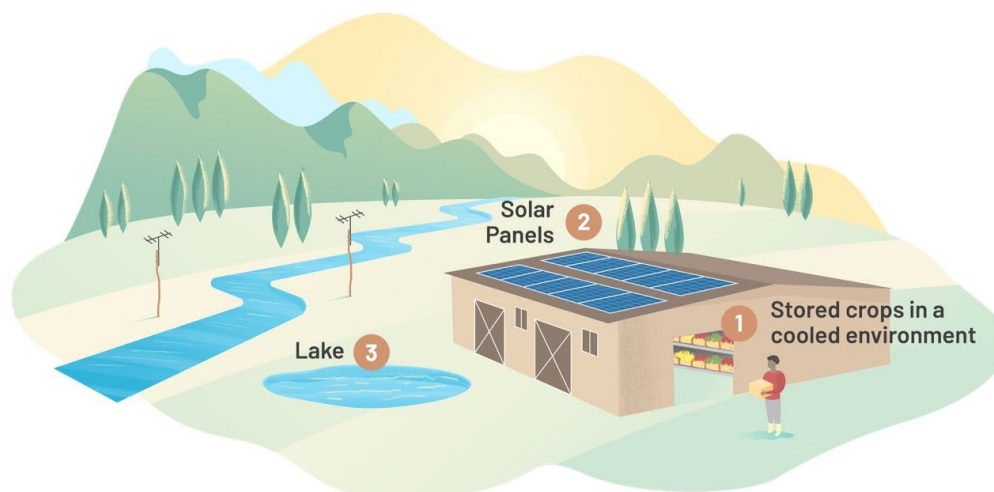


Figure 9: Solar-powered cold storage unit to store crops

Activities

- Activity 2.2.4.1: Promote fast growing and drought resistant crop varieties.
- Activity 2.2.4.2: Provide inputs for irrigated agriculture technologies (Drip irrigation, small irrigation etc.).
- Activity 2.2.4.3: Promote climate-smart agricultural practices supported by innovative software/apps.
- Activity 2.2.4.4: Promote (cold) storage management to prevent decay of crops.

COMPONENT 3.

Strengthening the capacity of stakeholders to manage flood and drought risks due to climate change effects.

44. The current capacity to integrate flood and drought risk management into development plans is inadequate to ensure effective implementation of flood and drought resilient tools, technologies, and practices. Furthermore, the country has limited financial resources for climate investments in the water sector, which hampers effective flood and drought risk management. Inadequate flood and drought risk management leads to adverse impacts for people, especially for vulnerable communities in the selected regions. These shortcomings therefore limit communities’ ability to enhance resilience to flood and drought events.

45. Component three aims to strengthen the adaptive capacity of various stakeholder groups at different levels of society to enhance their resilience to (climate change-induced) flood and drought events. Stakeholder groups include: (i) national and sub-national governments, (ii) disaster management authorities, (iii) smallholder farmers, (iv) pastoralists and (v) vulnerable stakeholder groups in particular (e.g. women and children). The proposed programme shall establish a common understanding of stakeholders’ needs regarding flood and drought adaptation. The programme shall strengthen stakeholders’ capacity to manage flood and drought risks. The programme shall develop capacity building and training plans.

46. The activities for this component are highlighted below under outcomes: 3.1 and 3.2 in outputs 3.1.1, 3.1.2 and 3.2.1.

Outcome 3.1: Flood and drought resilience of key stakeholders at national and sub-national level strengthened.

47. The adaptive capacity of people and institutions shall be strengthened through capacity building and supporting plans. Workshops, educational programmes, and training sessions shall be provided to key stakeholders at different levels of society. Simultaneously, plans shall be developed to support flood and drought risk management activities of the key stakeholders. Strengthened capacity of the key stakeholders enables sustainable resilience to flood and drought risks using the tools, technologies and practices implemented as part of the proposed programme.

Output 3.1.1: Flood and drought management plans (FDMPs) integrating climate change aspects and adaptation actions are developed.

48. There are likely multiple plans that cover flood and drought risk management activities for different authorities at national and sub-national level. It is imperative to standardise and centralise flood and drought management plans to enable a common approach to mitigate flood and drought risks with clear roles and responsibilities. These plans shall be disseminated to relevant people and authorities.

Activities

- Activity 3.1.1.1: Develop/update existing FDMPs at national and sub-national levels integrating climate change elements and adaptation actions.
- Activity 3.1.1.2: Ensure alignment FDMPs with national and international climate objectives and national development plans and programs.
- Activity 3.1.1.3: Promote and disseminate FDMPs for use by stakeholder groups (e.g. disaster management authorities, farmers and pastoralists).
- Activity 3.1.1.4: Support effective adoption/embedding of FDMPs in governmental policies and practices e.g. by developing bylaws.

Output 3.1.2: Adaptive capacity of institutions, farmers, and pastoralists in flood and drought management is improved.

49. The proposed programme shall organise (i) educational programmes, (ii) capacity building workshops and (iii) training sessions to improve the capacity of people and institutions at national and sub-national level. The capacity building activities shall be customized for each stakeholder groups. Marginalized and vulnerable groups shall undergo capacity building activities.

Activities

- Activity 3.1.2.1: Undertake a capacity needs gap analysis to effective flood and drought management.
- Activity 3.1.2.2: Develop capacity building plans and supporting materials/toolkits for national, regional, and local stakeholder groups including governmental organisations.

- Activity 3.1.2.3: Organise visits and learning tours for cross-learning in areas with successful flood and drought management innovations including best water management practices.
- Activity 3.1.2.4: Train stakeholder groups at all layers of society on how to operate and maintain flood and drought adaptation measures/technologies implemented as part of this project including mobile flood barrier, flood and drought early warning system, irrigation system and the water harvesting infrastructure.
- Activity 3.1.2.5: Train farmer and pastoralist groups innovative climate smart agricultural extension services. These smart agricultural services are supported by innovative software/apps.

Outcome 3.2: Partnerships for flood and drought management at national and sub-national level strengthened.

50. The proposed programme follows a participatory approach to ensure ownership with the relevant people and institutions. Flood and drought risk management impacts and requires involvement of various stakeholder groups at different levels of the society. It is imperative that arrangements are made between the different stakeholder groups who are involved in flood and drought risk management activities. These arrangements enable a paradigm shift to realise a sustainable mitigation of flood and drought risks.

Output 3.2.1: New/existing national and sub-national arrangements/networks for flood and drought management supported.

51. Agreements between stakeholder groups related to flood and drought risk management shall be centralised, updated, and ratified. These agreements shall define the flood and drought risk management processes and the different roles and responsibilities. The different stakeholders must agree on the arrangements to ensure that the flood and drought risk mitigating solutions are sustainable.

Activities

- Activity 3.2.1.1: Undertake gap analysis on agreements (e.g. MoUs) for flood and drought management between different stakeholder groups at different levels of society.
- Activity 3.2.1.2: Develop/upgrade national and regional flood and drought management multi-sectoral/stakeholder agreements and platforms to coordinate partner efforts. Ensure a periodical review of the agreements and platforms.
- Activity 3.2.1.3: Support national and regional partners to jointly mobilize resources for flood and drought management in a changing climate context.

**COMPONENT
4. **

Enhancing knowledge management, awareness creation and information sharing on flood and drought risks.

52. There is a lack of awareness on flood and drought risks and adaptation tools, technologies and practices amongst stakeholder groups including governmental institutions leading to poor planning and responses to flood and drought events resulting in adverse impacts such as low crop and livestock yields leading to food insecurity and low incomes. This component seeks to

support knowledge generation, packaging, and dissemination between and across stakeholders in various institutions within the country.

53. The specific activities of this component are highlighted under outcomes 4.1 and 4.2 and outputs 4.1.1 and 4.2.1.

Outcome 4.1: Strengthened awareness and ownership of flood and drought adaptation and climate risk reduction processes at local level.

54. The activities of the proposed programme facilitate people and institutions to (i) generate knowledge on flood and drought risk management, (ii) undertaking study tours, (iii) exchange visits, (iv) documenting lessons learned or best practices and (v) generally facilitating knowledge exchange. The information, lessons learned, best practices and innovative technologies will be documented and shared for the use by various stakeholder groups.
55. Adaptation knowledge products will be prepared and transferred within and among people and institutions. They will focus on the implementation of concrete adaptation interventions that are effective in building resilience to floods and droughts. The knowledge products generated by the proposed programme will be shared via knowledge platforms and forums across, as well as through knowledge-sharing events at the demonstration sites.

Output 4.1.1: Good practices and lessons on flood and drought management disseminated.

56. The proposed programme defines knowledge management objectives with the different stakeholders involved in flood and drought risk management. Subsequently, knowledge products are identified to realise knowledge management objectives. There shall be a knowledge platform that is a single source of flood and drought knowledge, which accessible to relevant people and institutions. This knowledge management platform is used to share knowledge such as best practices, lessons learned and the realization of (inter)national objectives.

Activities

- Activity 4.1.1.1: Document and disseminate lessons and best practices from project interventions. These lessons learned and best practices contain recommendations to improve flood and drought adaptation practices.
- Activity 4.1.1.2: Establish framework/platforms to disseminate/share knowledge and information on flood and drought risk management. The aim is to standardise and centralise (single source) flood and drought knowledge and information that is easily accessible to the stakeholders with a clear description of roles and responsibilities to manage knowledge and information.
- Activity 4.1.1.3: Generate and package information dissemination materials on flood and drought adaptation actions and climate change that is easily accessible by the various stakeholder groups. Packaged information should meet requirements international standards e.g. reporting on realisation of NDCs or SDGs.

Output 4.1.2: Flood and drought information management strengthened.

57. Knowledge sharing requires a paradigm shift by embedding related activities in business-as-usual processes. Detailed runbooks are developed, and gatherings shall be organized to establish processes and procedures, and to define roles and responsibilities with regards to

knowledge sharing. A Monitoring and Evaluation expert will be appointed who is responsible for measuring and reporting on the flood and drought risk management impact that is realised with the implemented adaptation tools, technologies and practices.

Activities

- Activity 4.1.2.1: Develop runbooks describing actions to be taken by different stakeholder groups with different types of flood and drought information and knowledge.
- Activity 4.1.2.2: Engage policymakers in the dissemination of flood and drought management information and best practices.
- Activity 4.1.2.3: Support flood and drought management working groups to share and disseminate the information. This involves organizing workshops and meetings for vulnerable groups of women and youth to share and disseminate information on drought management.
- Activity 4.1.2.4: Establish monitoring and evaluation activities and therewith facilitate empowerment of women, children, and other vulnerable groups on water management.

B. Promotion of new and innovative solutions to flood and drought adaptation

58. Burundi has been experiencing an increase in adverse impacts from drought events due to climate change. Exacerbated drought events impact the socio-economic wellbeing of the country at national and sub-national level. The four selected provinces in the programme experience, on top of drought, an increase in adverse impacts from flood events due to climate change. Burundi is highly dependent on agriculture and pastoralism to support livelihoods and both sectors are climate sensitive considering the dependency on natural resources.
59. Burundi's institutions and communities are amongst the least ready to adapt to climate change and are therefore highly vulnerable to flood and drought events. The ability to recover from flood and drought events is also limited. To reduce the vulnerability of the country, the programme shall implement a unique combination of innovative solutions to enhance resilience to flood and drought risk.
60. Design and implementation of the programme follows a participatory approach by involving different (public and private) stakeholder groups at different levels of society. The programme shall organize workshops, visits, gatherings to co-design the solutions with the various stakeholder groups. By leveraging local expertise during the co-design process, the tools, technologies and practices might be customized to meet local specific requirements.
61. Weather information services such as EWSs that are operated on a national level should also reach stakeholders such as communities. This programme shall establish communication channels between stakeholder groups such as specific apps. The programme shall also establish platforms and periodical meetings to easily share information such as lessons learned between stakeholders.
62. The programme follows a holistic approach towards flood and drought resilience comprising of a unique combination of streamlined innovative tools, technologies, and practices. The

information services such as EWSs will be made available for different stakeholder groups with a distinct focus on vulnerable groups such as women and youth. Similarly, (i) the innovative water-filled mobile flood barrier, (ii) water harvesting infrastructure and (iii) an innovative irrigation system will be implemented to support stakeholders.

63. Another innovative element of this programme is the implementation of a newly developed solar-powered cold storage facility to extend the shelf life of crops and therewith improve food security and the economy. This will be a new way of farming and consumption for farmers and community members.
64. Workshops and forums will be organized to promote the usage of the innovative products and services that are part of the holistic approach to enhance resilience to floods and drought. Training and capabilities development will be provided not only to operate and maintain the innovative climate adaptive interventions, but also to extract as many benefits of them as possible.
65. The programme shall promote innovative farming and pastoralism practices to increase resilience to climate change. There are for example innovative methods to reduce the required water to a minimum to grow crops. The programme shall guide farmers on what crops to grow and when and where to grow these.
66. A logistical system will be designed to ensure efficient and effective supply of goods such as crops and livestock products. The programme shall establish market linkages between producers and potential buyers. This will be possible through facilitating producers to participate in (i) interviews, (ii) business tours, (iii) supporting producers in trade shows, (iv) business forums etc. T
67. The programme shall also explore the possibility to introduce and promote innovative insurance Index-based weather insurance in partnership with insurance companies. Insurance products will be promoted that could help stakeholders reduce and offset climate change-related losses.
68. The programme shall collaborate with research institutes (e.g. the University of Delft) to promote innovative products and services implemented as part of this project. They will be encouraged to participate and write a scientific paper on this programme. The programme shall use the network of the research institutes to promote the innovative flood and drought resilient measures. Various universities in The Netherlands for example are known to be actively involved in project in the water and agriculture sector.

C. Rollout of successful innovative adaptation practices, tools, and technologies

69. The programme shall start off by analyzing flood and drought risks as well as the climate adaptation practices, tools and technologies that are currently being used in the country. The selected four provinces will require a more granular analysis.

70. The relevant project teams shall (i) hold workshops (brown paper sessions), (ii) perform desk research, and (iii) hold interviews to get a better understanding of flood and drought risks. These analyses result in a common understanding of the “as-is” situation regarding current flood and drought resilience tools, technologies, and practices.
71. The relevant project teams shall analyse the desired adaptation tools, technologies, and practices on national and sub-national level. This analysis is conducted through: (i) workshops (white paper sessions), (ii) consultations with experts, and (iii) desk research. These analyses result in the “to-be” situation regarding current flood and drought resilience tools, technologies, and practices.
72. The differences between the as-is and to-be situation are the “gaps”. These gaps reflect what is currently missing in the design and execution of tools, technologies, and practices. Workshops will be held to discuss the gaps and determine follow-up actions. Gaps can be closed fully, partially, or not at all. Gaps that cannot be closed fully during this programme require recommendations on how to limit the impact of the gap and how to close it in the future.
73. Plans will be designed to close gaps and improve flood and drought resilience by implementing a unique combination of streamlined innovative tools, technologies, and practices. These plans must be approved by all relevant stakeholders to ensure that the implementation will run smoothly. Workshops will be held for different stakeholder groups in Burundi to give a demonstration of the envisioned adaptation tools, technologies, and practices.
74. The co-design process leads to agreed implementation plans. Design and execution of these plans are done in separate projects with the programme organized by the type of interventions: (i) information technology, (ii) technical/physical interventions and (iii) capacity building and knowledge management.
75. There is an overarching programme board that communicates the blueprint/vision of the programme and ensures there is alignment between the different projects. The programme board monitors the progress of the design and execution of the plans and it authorizes any major changes from the agreed plans. Each project will have its own project board to steer the project in the right direction by monitoring progress and authorizing minor deviations from the original plan in terms of time, quality, and costs. It is imperative to include staff in the project teams who have the right capabilities to design and execute the agreed plans. A key role in each project team is that of a local focal point who is well known with and respected by various stakeholder groups at different levels of society in the country.
76. To ensure that adaptation tools, technologies, and practices are rolled out successfully, the programme shall establish a Monitoring and Evaluation (M&E) framework. M&E activities will be executed to ensure that the interventions are effective and sustainable. An M&E team shall be appointed to periodically keep track of the workings/effectiveness of the implemented interventions. The team shall record and report on deviations from the anticipated results including an analysis on the root cause of said deviations. These analyses include recommendations on how to resolve or build upon deviations. A committee shall be installed to evaluate feedback from the M&E team. The committee is mandated to decide how to follow-up with the analysis and recommendations by the M&E team.

77. This holistic approach towards flood and drought risk management comprises of a unique combination of streamlined innovative products and services. This unique combination of innovative adaptation tools, technologies and practices can be a blueprint for future programmes in the water sector. Virtually all countries in Africa experience adverse impacts from climate change-induced flood and drought events and they are eager to find a solution.
78. Research shall be done to identify locations/regions in Burundi, and possibly other countries, where this unique holistic approach to flood and drought risk management could potentially be replicated. A stakeholder mapping document will be developed to identify which stakeholders are responsible for enhancing resilience to floods and drought in the identified locations/regions. The programme shall develop decision trees/matrices to evaluate what locations are suitable for the innovative interventions. This tool can be used when deciding to scale-up the unique combination of interventions elsewhere.

D. Economic, social and environmental benefits

79. The programme is designed to realise the most economic, social, and environmental benefits especially for the most vulnerable groups. These benefits will be aligned with national and international (climate) objectives as included in national adaptation plans and strategies. A specific flood and drought Adaptation Benefits Mechanism (ABM) methodology will be developed and applied to measure and monitor the anticipated and realised benefits from the interventions. This methodology comprises of a baseline methodology and a monitoring methodology.
80. Measuring the Adaptation Benefits (ABs) is supported by one of the innovative technologies that will be implemented as part of this project, being a newly developed Flood Intelligence Service (FIS) tool. This software calculates the ABs from flood resilient interventions expressed in monetary and non-monetary values. Additional information services and toolkits support measuring and monitoring adaptation benefits. The ABM methodology and supporting tools allow to measure and monitor ABs specifically for vulnerable and marginalized groups such as women and youth. In realizing these ABs, the programme remains compliant with the Environmental and Social Policy (ESP) of the Adaptation Fund (AF).
81. The benefits are described in below paragraphs and an overview of the benefits is included in Table A in Annex 1.

Socio-Economic benefits

82. The programme will directly contribute to improving the populations' livelihoods, nation-wide and across the four selected provinces, through innovative approaches and measures and income-generating activities. Preventing damages from flooding and improving water security will improve the livelihoods of farmers and pastoralists and by extension other vulnerable groups such as women and youth.
83. Climate change has exacerbated flood and drought events the last decades, however the number of casualties and injuries has decreased significantly. One of main reasons for the

decrease in human loss is due to the implementation of EWSs. By implementing EWSs and other weather information services, the programme will reduce the number of casualties and injuries.

84. Promoting smart agriculture practices such as the usage of drought-resistant crops and drought tolerant breeds of livestock will increase production. By aligning production with customer demand, the incomes of farmers and pastoralists will inevitably increase. This will lead an increase in income and to new jobs.
85. The programme shall explore the possibility to setup local facilities or teams to manufacture/operate/maintain innovative tools and technologies. For example, there is an option to setup a local facility in Burundi to assemble/produce the mobile flood barrier. This would create new jobs and Burundi could serve as an exporting hub in Eastern Africa.
86. Water harvesting infrastructure ensures access to water in times of drought for irrigation purposes and as drinking water livestock. This helps prevent epidemics and other diseases.
87. Flood resilient interventions ensure that there will be less inundated agricultural land. In turn, this limits the risk of waterborne diseases. This will also enhance access to infrastructure such as roads for the population to move to other locations or to visit healthcare facilities or schools.
88. Another benefit from flood and drought resilient interventions is reduced social unrest, conflicts and, migration of community members seeking water and other sources of livelihoods. These interventions will socially improve people's stability and prevent the necessity to migrate to other regions or countries.
89. The programme ensures that the interests of vulnerable groups such as women and youth are at the forefront when designing and implementing the flood and drought resilient solutions. The programme will set targets to ensure that an adequate number of people who represent these vulnerable groups are involved in the design, implementation and execution of the adaptation tools, technologies, and practices.
90. Overall, the planned interventions of the proposed programme provide concrete socio-economic and environmental benefits to ecosystems and populations especially the vulnerable groups including women and youth. Food security will increase on a national scale and in addition the flood and drought information services are aimed to have a national reach and therewith enhancing resilience to climate change nationwide. The four selected provinces will receive flood and drought resilient technologies such as water-filled mobile flood barriers and irrigation systems. The planned interventions will not only make the vulnerable and marginalized groups resilient to flood and drought events, but also provide them with concrete benefits such as (i) food and water security, (ii) reduced damages to land, assets and people and (ii) increase in income and new jobs.

Environmental benefits

91. The holistic approach to strengthen resilience to flood and drought events will have a positive impact on the protection, restoration, and management of the natural ecosystem. The

combination of information technology services with technological interventions will reduce the vulnerability to climate change-induced flood and drought. Enhanced information management and improved flood protection, water harvesting, and irrigation systems will be embedded in contingency plans/emergency plans. The programme shall develop specific contingency plans based on the analysis of the vulnerabilities of ecosystems and populations.

92. The programme shall increase awareness amongst the population and institutions on the necessity and method to protect, restore and manage the environment in a sustainable manner. The country faces many climate challenges and environment-related benefits don't have the highest priority as it stands. It is therefore imperative that the programme creates awareness and conveys the message that benefits for the environment and socio-economic benefits are intertwined.
93. The development or improvement of flood and drought risk management plans will give clarity on how resilience is enabled among different stakeholder groups at all levels of society. These plans reflect the processes and roles and responsibilities to manage flood and drought risks. Benefits for the environment will be explicitly included in the plans to ensure that the population and institutions follow-through with their behaviors and practices to realise benefits for the environment and biodiversity.
94. The implementation of physical technologies such as water-filled mobile flood barriers and climate smart agriculture practices will result in concrete benefits for the environment and biodiversity. Flood protection prevents (agricultural) land from being inundated, which causes damages to the environment. Smart agriculture practices ensure that farmers and pastoralists utilize natural resources to limit the impact on the environment and biodiversity.
95. The programme shall enhance water availability for the population, for livestock and to irrigate agricultural land. Water security is essential for a flourishing environment and biodiversity. Efficient use of water ensures there is little waste and increases the ability to meet the demand.
96. The unique combination of innovative flood and drought resilient measures and supporting risk management plans can be a blueprint for other regions/countries to protect, restore and manage the environment. The programme shall specify what the benefits are for the environment. The interventions and their positive impact on the environment and biodiversity will be communicated to stakeholder groups in Burundi and possibly other (neighboring) countries to determine whether other regions can also realise such a positive impact. The programme shall organize workshops, lessons learned sessions, webinars, field visits and other means of knowledge sharing and awareness-raising to showcase the environmental benefits. The goal is to spread the usage of the practices, tools and technologies to protect, restore and manage the environment and biodiversity.
97. The programme shall take the necessary actions to mitigate the negative impacts of the interventions in compliance with ESP, Environmental and Social Impact Assessment (ESIA) and the GP of the AF. The programme has developed these actions following consultations with different stakeholder groups.

E. Cost-effectiveness of the proposed project / programme

98. The programme is cost-effective throughout its four components. Reducing the costs to a minimum will increase the likeliness that these innovative products and services will be scaled up, ideally without financial support from donors. Where possible, the cost-effectiveness will be measured and monitored by comparing the financial investments with the ABs using predefined indicators expressed monetary and non-monetary values. An important feature of the innovative adaptation tools, technologies and practices is that these are more cost-effective compared with the (conventional) alternative solutions.
99. The first component aims to create an enabling environment for climate change adaptation at all layers of society. The approach to enhance the cost-effectiveness of this component is to perform a gap analysis and formulate recommendations to close gaps without excessive spending. The programme aims to realise operational excellence and cost-effectiveness through standardisation and centralisation of information technology (hard- and software), related processes and data sources. Standardisation and centralisation enable clear communications between different stakeholder groups at national and sub-national level; this prevents a waste of time and therefore funds.
100. The second component focuses on cost-effective design and development of flood resilient technologies including the mobile flood barrier. The programme will implement the FIS tool under component one that analyses the ABs from flood resilient solutions. This tool allows a cost-effective design of the flood resilient solutions to realise the most ABs. One advantage of the water-filled mobile flood barrier compared to conventional structural measures is that it can be deployed at different locations and at different points in time. The solution can cover a large area making it a cost-effective solution. Water-filled mobile flood barriers are significantly more durable compared to conventional sandbag systems.
101. An analysis was conducted by members of the University the Delft in The Netherlands to evaluate the cost-effectiveness of the mobile flood barrier compared to the other flood prevention measures such as sandbags. The analysis showed that the return on investment was the fastest with the water-filled flood barrier. A similar analysis will be conducted as part of the feasibility study for the full proposal.
102. Furthermore, the second component aims to enhance cost-effectiveness with the other technologies including (i) the water harvesting structure, (ii) irrigation system and (iii) solar-powered cold storage. A water harvesting structure will be implemented such as a water tower or a lake to harness flood/rainwater. The structure will be built upstream which is positioned at a higher altitude. The irrigation system takes water from the water harvesting structure to irrigate a large area of land downstream. Gravity enables movement of water through the irrigation system; this is a durable setup that is low in costs. A solar-powered cold storage unit will be installed to store produce in a cooled environment and therewith prevent spoiling of fruits and vegetables. Solar power is significantly more cost-effective compared to cold storage facilities that are powered by generators.
103. Under the third component, the programme will mainstream climate change adaptation in the water sector into existing strategic and operational frameworks (national strategies, policies,

development plans, planned programs etc.) instead of developing new plans and frameworks. As such, the programme will support a cost-effective approach while also encouraging national ownership over the programme outputs.

104. Furthermore, the third component aims to raise awareness and strengthen capacities mainly in flood and drought adaptation across different stakeholder groups at different levels of society. The enhanced activities include climate smart agricultural and pastoral practices in various institutions at the national and sub-national level. Capacity building activities include “train-the-trainer” workshops to ensure that local people can train others as opposed to involving foreign, more expensive, trainers.
105. The fourth component will realise cost-effective knowledge management through the centralisation and standardisation of supporting tools and related processes. It is imperative to share knowledge on flood and drought risks and adaptive measures amongst many different stakeholder groups. Sharing lessons learned will help enhance cost-effectiveness of climate adaptive actions. Standardisation and centralisation of knowledge management enable clear and effective communications between different stakeholder groups at national and sub-national; this prevents a waste of time and therefore funds.
106. The pandemic situation has taught us that projects/programmes can be implemented successfully without excessive traveling between countries. The quality of online/virtual meetings has improved significantly therewith limiting the need to travel frequently between countries. This contributes to the cost-effectiveness of the programme.
107. Lessons learned from past projects confirm that costs can be saved by holding multi-disciplinary field visits at the beginning of the project. This creates a common understanding amongst members of the project organisation with regards to various elements of the project such as the suitability of the different project sites. Having a common understanding at an early stage of the project enables an effective and time-efficient implementation of the project.
108. The project will also seek synergies and complementarities with ongoing initiatives and programmes having similar objectives whilst avoiding overlaps. Interventions will be coordinated closely with other relevant ongoing initiatives implemented in the country. Cost-effectiveness will be achieved through synergies and complementarities.

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

109. Despite that Burundi has been characterized as one of the countries in the region that are ‘less actively engaged’ in climate change adaptation, the country has prepared national strategies and policies for climate change and participated in the United Nations Framework Convention on Climate Change (UNFCCC) conferences and agreements.
110. Burundi has ratified (i) the United Nations (UN) Convention on Biological Diversity (CBD) for which it elaborated a Biological Diversity National Strategy and Plan of Action, (ii) the Convention to Combat Desertification (CCD) for which it elaborated a National Plan of Action to

Combat Desertification, (iii) the Framework Convention on Climate Change (UNFCCC) and (iv) the Kyoto Protocol. Burundi signed the Paris Agreement in April 2016 and ratified the agreement in January 2018 with it entering into force in February 2018; see Nationally Determined Contributions (NDCs) below. It has prepared two National Communications for the UNFCCC and a National Action Plan for Adaptation (NAPA)²³. The programme contributes to the following priorities of Burundi's NAPA:

- Install mechanisms to control erosion in sensitive areas.
- Control the river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura.
- Popularise short cycle and dryness resistant food crops.
- Popularise rainwater harvesting techniques for agricultural or domestic use
- Establish and protect strategic buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera.
- Train and inform the decision makers and other partners, including the local communities on the methods of adaptation to climate variability.
- Improve seasonal early warning climate forecasts.

111. In 2012, Burundi finalised its National Climate Change Strategy and Action Plan²⁴. Early 2015, Burundi published a report on its progress on activities under the Hyogo framework for action. Three areas were identified as priorities for the future to which FDR1 will contribute:

- Integrate disaster risk reduction into policies and plans for sustainable development.
- Develop and strengthen institutions, mechanisms and capacities to build resilience to hazards.
- Systematically consider risk reduction in emergency preparedness/response/recovery activities²⁵.

112. Burundi submitted its First NDC in January 2018 to the UNFCCC²⁶. In its NDC Burundi presents itself as being vulnerable to climate change. It projects that climate change affects every economic sector in the country, but will particularly impact agriculture and hinder the development of hydropower. To successfully adapt to climate change, Burundi's NDC proposes to prioritise actions that reflect the priorities identified in its National Strategy and Action Plan on Climate Change (2012); FDR1 contributes to many of these priorities:

- Integrated management of climate risk and forecasts over time (by means of probabilities and forward-looking studies) so as to be able to take action in advance.
- Protection of aquatic and land-based ecosystems.
- Coaching of the population to develop their resilience to climate change.
- Development of institutional and operational capacities to coordinate programmes that are resilient to climate change.
- Establishment of functional monitoring and evaluation mechanisms for climate change, as well as knowledge management and information mechanisms.
- Enhancement of data and information management and distribution mechanisms.

²³ Burundi Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

²⁴ Nile Basin Initiative (2013): Climate Change Strategy. www.nilebasin.org/index.php/media-center/publications/doc_download/104-nbi-climate-change-strategy

²⁵ HFA (2015): Burundi - Rapport national de suivi sur la mise en oeuvre du Cadre d'action de Hyogo (2013-2015) - Interim

²⁶ The First NDC is the INDC that was submitted to September 2015 prior to the Paris COP

- Reinforcement of climate change impact tracking systems by means of observations and investigations.
 - Strengthening of the information and data communication and exchange system.
113. Burundi has ratified a Technology Needs Assessment (TNA)²⁷ and a Technology Action Plan (TAP)²⁸ related to climate adaptation. The TNA states that sectors most vulnerable to climate change agriculture comes first, followed by the water resources, energy, environment, and natural ecosystems sectors. It is for this reason that the Agriculture and Livestock sector and the water resources sector have been selected as priority sectors in the TNA for adaptation to climate change. Three technologies in the Water Resources sector and three technologies in the Agriculture and Livestock sector have been defined which are deemed “high priority” for the country. The high priority technologies in the Water Resources sector center around: (i) monitoring water quantities, (ii) harnessing rainwater and (iii) control of the rain dynamics. The high priority technologies in the Agriculture and Livestock sector center around (i) soil conservation systems, (ii) development of the short cycle rice variety and (iii) community early warning systems. The TAP of Burundi defines the technologies and projects that are being implemented to meet the high priority technical needs. The activities of the proposed programme are fully in line with the high priorities as stipulated in the TNA and the TAP. The programme shall align with the TNA and the TAP and ensure there is no duplication.
114. The programme is aligned with national and relevant sub-national key strategic documents, policy documents and ongoing/planned projects related to climate change adaptation in the water sector. The programme will contribute to achieving the respective national adaptation priorities and corresponding national and international objectives. Table B in Annex 1 reflects how this programme contributes to and complies with relevant national/regional strategies, plans and programs.
115. As per 2018, only one of the priority areas of the NAPA has been implemented (improve early warning climate forecasts). Others remain unfunded so far, leaving several vulnerable sectors without action on the identified priorities (including agriculture, freshwater and forestry). To successfully adapt to climate change, Burundi’s NDC proposes to prioritize actions that reflect the priorities identified in its National Strategy and Action Plan on Climate Change (2012)
116. The programme will liaise with owners of Burundi’s strategies/programs/plans to establish linkages between objectives, outcomes and outputs. The extent to which this programme contributes to (inter)national objectives, such as the Sustainable Development Goals (SDGs), will be embedded in the M&E framework. The M&E team is responsible for keeping track of the realization of the project targets and therewith the contribution to Burundi’s (sub-)national strategies, plans and programs.

G. Compliance with national technical standards

²⁷https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNA_key_doc/e2a748d4d7fb46a886411a2739cf72d7/eb976df133a34e74b758e3e22fd15490.pdf

²⁸https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNA_key_doc/2f913115be3049faa26a1e1a7facbfe7/3f6fe789960247acbee711dda0cbfd72.pdf

117. The programme and all members of the programme organisation shall comply with the AF standards and policies such as the ESP and the GP. To ensure the national ownership and sustainability of the outcomes, the programme shall also be implemented in compliance with the (inter)national standards.
118. The programme organisation shall include members/representatives with the right capabilities to ensure compliance with standards such as Environmental Impact Assessments (EIAs). The programme shall conduct a screening of the programme activities and assess their impacts and, depending on the magnitude of the impacts, these will undergo an EIA or review in accordance with EIA procedures and guidelines. Appropriate responses will be formulated and discussed following the outcome of the EIAs.
119. Consultations have been held with various stakeholders to evaluate the technical standards such as (i) the Environmental Assessment Standards, (ii) the Risk and Disaster Management Framework, (iii) the National Early Warning and (iv) the Response Mechanism. Tables C and D in Annex 1 reflect linkages between the standards and the planned activities of the project.
120. The ESIA is consistent with Burundi's legal framework, particularly Law No. 1/010 2000 instituting the Burundi Environmental Code and Decree No. 100/22 of 7 October 2010 relating to measures for implementing the Burundi Environmental Code and ESIA procedures. The detailed assessment concluded that the activities proposed by the project are fully compatible with relevant national standards pertaining to the country's political, legal and technical framework. These activities include data management, water management, disaster risk management, flood and drought EWS, crops and livestock production and training of target audiences. Controls will be put in place to limit the risk of social or environmental harm.
121. Note that not all laws related to the principles set forth by the Adaptation Fund have been ratified by the Government of Burundi. Where the laws have not been ratified, the programme will adhere to the (spirit of) the Environmental and Social principles as published by the AF.

H. Duplication of the programme with other funding sources

122. The programme has done a study on the completed, ongoing, and planned initiatives in Burundi and to what extent these are complementary or overlapping. The goal is to avoid duplications and ensure alignment with ongoing and planned initiatives. Various sources containing programmes in Burundi have been studied including (i) the World Bank, (ii) The AF, (iii) the GEF (Global Environment Facility), (iv) the GCF (Green Climate Fund), (v) the GCA (Global Center of Adaptation) and (vi) the AfDB (African Development Bank).
123. Furthermore, stakeholder consultations have been conducted with the sole intention to avoid any potential duplication of efforts, resources, or geographical coverage, and to ensure alignment between ongoing initiatives and this programme.
124. Table E in Annex 1 summarizes the main planned and ongoing initiatives in the same field as this programme i.e. flood and drought risk management in Burundi. The table reflects how these initiatives are aligned with this programme and whether there are duplications.

125. It is imperative to conduct gap analyses at an early stage of the project to ensure there is no duplication with other programs/funding sources. Any unforeseen duplications will come to light when conducting gap analyses through multi-stakeholder workshops.
126. Table F in Annex 1 provides a mapping of the core interventions and possible duplication with planned, ongoing, and completed programs that ought to be addressed during gap analyses.
127. Overall, the conclusion is that there are planned, ongoing and completed programmes in Burundi to enhance resilience to climate change in the water sector, albeit a limited number of programmes compared to other (developing) countries. Some of these programmes harbor the risk of duplication, especially with regards to (i) flood and drought early warning, (ii) capacity building and (iii) strategic plan and policy development. Further analysis is required to what extent the possible duplication impacts this programme, the results of which shall be included in the full proposal.

I. Learning and knowledge management

128. The programme has defined actions to ensure that knowledge of an individual or institution reaches the largest number of beneficiaries as quickly as possible. Component four of the programme is fully dedicated to address awareness raising, knowledge management and communication. Whilst this provides the cornerstone for capturing and disseminating lessons learned, other project components directly contribute to knowledge management mechanisms and dissemination of lessons learned from local to national and to international levels.
129. Knowledge pertains to people's experience, analysis, and exchange with regards to the adaptation practices, tools, and technologies as well as the programme itself. The programme shall develop a knowledge management strategy that sets the long-term direction, scope, and objectives (short- and long-term) that are systematically pursued and eventually achieved through proper resource planning.
130. The programme identifies three phases during which a certain type of knowledge management activities take place: (i) during the analysis phase, (ii) during the implementation phase and (iii) after implementation. Each phase has a specific objective related to knowledge management that comes with corresponding activities. The objectives are respectively to (i) create a shared understanding on how to improve the current situation, (ii) to optimize the implementation and (iii) to improve upon the implemented adaptation interventions.
131. The programme furthermore ensures that people and institutions actively participate in knowledge management activities. Active participation is encouraged by making easily accessible tooling available that support knowledge management activities. The importance of knowledge management will be addressed on a frequent basis to ensure it is embedded in the programme culture.

132. The knowledge management strategy includes adaptive management and the development of learning objectives and indicators. Keep track of experiences gained from the Fund and analyze them periodically both to enrich the global knowledge on climate change adaptation and to accelerate understanding about what kinds of interventions work.
133. The programme shall develop the knowledge management strategy for the full proposal following these steps:
Step 1: Analyze existing knowledge, data, and communication products and media.
Step 2: Design the knowledge management strategy.
Step 3: Knowledge management implementation and monitoring.
Step 4: Evaluate, generate lessons learned, and disseminate.
- The different elements of the knowledge management strategy, captured in Table G in Annex 1, determine the most effective actions and knowledge management results most consistent with overall project objectives.
134. The knowledge management strategy guides the programme organisation on which knowledge management activities to conduct. The implementation and monitoring of the knowledge management strategy shall begin at the start of programme. At programme completion, the knowledge management strategy and activities are evaluated along with the rest of the programme.
135. The generated knowledge will be used by the different partners to improve and adjust the implementation of the programme, for political dialogue and for the design of future projects. This is particularly important given the quality and quantity of knowledge that is expected to be gathered, for the first time, from this project. This includes knowledge products on the innovative flood and drought adaptation practices, tools, and technologies such as water-filled mobile flood barriers. Knowledge products shall be publicly accessible and widely disseminated.

J. Consultative process

136. An initial consultative process has taken place with key stakeholders of the programme. The purpose of the consultation process is to ensure the interests of different stakeholder groups, especially vulnerable groups such as women and children, are incorporated in the design of the programme. Ultimately, all stakeholders should work towards a shared objective.
137. The consultation process started off with the identification of the different stakeholder groups whose support is needed or those who have another vested interest in this programme. The identification of these stakeholder groups was done in collaboration with a representative of the Ministry of Environment, Agriculture and Livestock of Burundi who is the focal point of the AF.
138. The consultation process was carried out by organizing online and onsite meetings with local authorities, field visits and workshops with community members. Events such as meetings and workshops aimed to have representatives of as many stakeholder groups as possible. The

discussions also focused on identifying and validating the threats/problems and needs of the selected territories. This enabled a consensus on the objectives, results and measures to respond to problems. The table below reflects the distribution of participants in consultations.

Table 3: Overview consultations and number of participants

Participants	<i>Men</i>	<i>Women</i>	<i>Disabled</i>	<i>Elders</i>	<i>Youth</i>	<i>Indigenous</i>
Consultation session 1: Online session with meteorologists and hydrologists on national level.						
<i>Public:</i>						
<i>Private:</i>						
Total:						

139. All participants in the consultation process were provided with a brochure/booklet that gave a high-level description of the programme. A presentation was also given during consultation events such as meetings and workshops. The consultation workshops and meetings aimed to:

- Provide information on the AF and the proposal development processes.
- Inform partners and beneficiary populations about the project scope and objectives.
- Listen to participants’ expectations and needs and take them into consideration in the design of the programme.
- Verify information collected from stakeholders and literature through triangulation.
- Define roles and responsibilities and their contribution to the programme.
- Outline specific actions for the most vulnerable groups such as women, and children.

140. The consultation process was conducted at national and sub-national level. Consultations at national level centered around programme execution as well as impact on and alignment with (inter)national plans, policies, and corresponding objectives. The consultations focused on how to govern with regards to climate adaptation tools, technologies, and practices and how to align activities at different levels. Consultations on local level were with the ultimate beneficiaries and centered around the impact of flood and drought events on the selected sites and how the new adaptation interventions can enhance resilience.

141. Preliminary discussions were held with officials working in the areas of hydrology, meteorology, and disaster management to understand the climate context and supporting policy environment as well as most pressing adaptation needs with regards to flood and drought. In addition, discussions were held with officials involved in sponsored climate programmes to get a view of initiatives in the country that ought to be aligned with this programme.

142. The key takeaways from the consultations are:

- Participants understand what the proposal development processes.
- Participants understand the project objectives and scope.
- There is a broad consensus on the flood and drought risks and the adaptation needs.
- Participants provided substantive and valuable feedback that shall be incorporated in the design of the programme.

143. The programme applies a feedback mechanism to allow for stakeholders’ views to be heard during project implementation. The programme will budget specifically for activities aimed at

attaining feedback from stakeholder who participated in the consultations. Feedback will be considered during the further implementation of the programme.

144. The consultation process will be expanded upon during the development of the full proposal. Parties involved in developing the full proposal shall agree on additional consultation needs for the full proposal.

K. Drawing on multiple perspectives on innovation.

145. The community-driven programme requires the involvement of various stakeholder groups to garner their perspectives on innovation. A co-design process ensures inclusive participation and continuous engagement of all partners, including buy-in and commitment. These partnerships help generate new solutions and scale those solutions to make progress. Involving all partners in co-designing the goals and scope of a given partnership is a critical step in ensuring its success and ability to create meaningful impact.

146. A co-design process on innovation is applied during the three phases of the programme i.e. (i) before implementation, (ii) during implementation and (iii) after implementation. The co-design process of the programme is an adaptation of the “*P.ACT: Partnership Co-Design Toolkit*”²⁹. The co-design process and the establishment of partnerships follows four stages:

- i. **Learn stage:** Explore and clarify partners' respective motivations, capabilities and cultures.
- ii. **Imagine stage:** Converge on the partnership value proposition, impact, and type of partnership.
- iii. **Create stage:** Define the partnership activities, roles, and governance structure.
- iv. **Evaluate stage.** Establish the distribution of value and costs and to define the partnership's monitoring metrics.

147. The programme lists the individuals and organizations that form a partnership. These stakeholders in a partnership are categorized as: (i) Customers, (ii) Community, (iii) Partners and (iv) Institutions. The table below provides an initial overview of the key stakeholders that are part of each partnership in this programme.

Table 4: Overview consultations and number of participants

Key stakeholder	<i>Partnership 1</i>	<i>Partnership 2</i>	<i>Partnership 3</i>	<i>Partnership 4</i>
<i>(i) Customers</i>				
1. Produce export traders	✓			✓
2. Smallholder farmers	✓	✓	✓	✓
3. Pastoralists	✓	✓	✓	
4. Representatives of agricultural cooperatives		✓	✓	✓
<i>(ii) Community</i>				

²⁹ <https://d-lab.mit.edu/resources/publications/pact-partnership-co-design-toolkit>

5. Farmer families (community)	✓	✓	✓	✓
6. Women's association	✓	✓	✓	✓
7. Indigenous peoples	✓	✓	✓	✓
8. Civil society	✓	✓	✓	✓
(iii) Partners				
9. Environmental expertise/field	✓			
10. Agricultural industries			✓	✓
11. Extension agents (e.g. training institutes)			✓	✓
(iv) Institutions				
12. Disaster preparedness and management	✓	✓		
13. Hydrology department	✓			
14. Environmental protection department		✓		
15. Agriculture and Livestock Research Institution		✓	✓	✓
16. Provincial Technical Services (Agriculture and Livestock)	✓	✓	✓	✓
17. Territorial administration		✓		
18. Local government	✓	✓		
19. Regional/provincial government	✓	✓		
20. Grant funder	✓			✓
21. Financial institutions (incl. insurer)	✓	✓		
22. Embassy of the Netherlands in Burundi		✓		
23. University of Burundi		✓	✓	
24. University in the Netherlands		✓	✓	

Definitions:

- *Customers: Individuals or entities who buy or pay for your products/services*
- *Community: Local community members benefiting from the partnership*
- *Partners: Individuals or entities working with the partners*
- *Institutions: Institutions providing an enabling environment for the partnership*

148. An expert shall be appointed to oversee the co-design process considering that most of the various stakeholders are unfamiliar with it. The expert works out the different elements of the co-design process, including the establishment of partnerships, and trains participants on their role and responsibilities. The expert will furthermore organize and lead conversations/workshops between partners.

149. By following the approach laid out in this section, the programme has the necessary collaborations planned to allow deployment and future scaling possibilities and risk management for the project. The programme draws on multiple perspectives on innovation from key stakeholders who will form a partnership.

L. Full cost of adaptation justification.

150. The proposed programme components, outcomes and outputs fully align with national and local government/institutional priorities. The programme reduces vulnerabilities of communities in Burundi and vulnerable groups and aligns with the outcomes as stated in the Adaptation Fund results framework. This alignment has resulted in the design of a comprehensive approach in which the different components strengthen each other and in which outputs and activities are expected to fill identified gaps of Burundi's current climate change response and corresponding institutional capacities.
151. The project aims to maximize the funding amount for the concrete adaptation component (component 2). Funding allocation to the other (softer) components is required for complementarity/support for component 2 and sustainability and quality assurance of the programme.
152. Additional funding from the Government of The Netherlands will be requested in the form of a grant in-kind. At the time of writing, the application has not started yet however the possibility of co-financing has been discussed with the representatives of the Dutch government. Should a grant in-kind be awarded, the regional scope will be broadened. However, the programme described in this proposal remains a stand-alone programme that can realise its objectives without co-financing.
153. The overall objective of the project is to increase local communities' resilience to climate change through resilient livelihoods and integrated natural resources management. The paradigm shift is to move from a "business as usual" characterized by unsustainable management of natural resources and agriculture practices to climate resilient agriculture and sustainable management of natural resources. The sections below describe how the baseline scenario (business as usual) and the alternative adaptation option under this proposal.

Baseline Scenario

154. An alternative without the proposed Adaptation Fund supported programme is a "business as usual" situation. Floods and drought continue to have a destructive impact on the socioeconomic wellbeing of Burundi and its population. Under current climate change trends there will be a significant impact on some of the principal food and commercial crops in Burundi. The main staple crops are bananas, cassava, sweet potatoes, and beans. Maize (a secondary staple crop), beans and sweet potato yields are expected to decrease gradually, with maize yield decreases of 5-25% predicted for the next decades³⁰. Rising temperatures and erratic or lower rainfall will have a negative impact on Burundi's primary exports of coffee and tea, which account for 90% of foreign exchange earnings³¹. Extreme floods and droughts are estimated to result in a reduction of long-term growth by 2.4% of GDP per year³².

³⁰ Baramburiye et al. (2013)

³¹ Ross, P (2015) Climate Change Effects On Coffee Production: How Hotter Weather Is Killing The Global Arabica Bean Market <http://www.ibtimes.com/climate-change-effects-coffee-production-how-hotter-weather-killing-global-arabica-1905151>

³² DFID (2011): The economic impacts of climate change in Burundi. <http://weadapt.org/knowledge-base/economics-of-adaptation/economics-of-adaptation-burundi>

155. The different project sites across the Cibitoke, Bubanza and Bujumbura Rural and Bujumbura Mairie Provinces are most vulnerable and prone to flooding and drought. Inaction will therefore impact communities in these regions the most.
- The communities at the project sites continue to experience high rainfall variability with increasing frequency and intensity of flood and drought occurrences and high environmental degradation.
 - Communities inhabiting such sites continue to be food insecure characterized by recurrent famine and a shortage of food.
 - There continue to be many vulnerable members among the smallholder farmers and pastoralists especially women, children, youth, disabled and elderly by gender. Low-income levels of the population/high poverty levels in such sites will remain.
 - Smallholder farmers and pastoralists have limited options in terms of the potential alternative sources of livelihoods and income.

Programme with Conventional Adaptation Measures

156. This alternative is to implement a programme that includes conventional measures to enhance resilience to flood and drought not necessarily taking into consideration climate change trends. The proposed programme contains a unique and holistic approach to enhancing resilience to flood and drought. Conventional measures and projects have shortcomings compared to the innovative approach of the proposed programme.
157. Conventional projects tend not to follow a holistic approach to enhance resilience to flood and/or drought. Such projects limit their activities to certain measures such as a software solution or structural flood preventive measures. Structural flood resilient measures can be expensive and can have a significant impact on the people and the landscape. Such measures don't always have the ability to adapt to changing weather patterns and changing landscape e.g. due to urbanization. In addition, these measures often require high skilled labour to operate and maintain these to ensure effective performance. Measures such as sandbags are not always effective, not in the least part because it takes a long time to deploy these during a flood situation. NBSs (Nature Based Solutions) can be effective but it often takes a long time for these solutions to develop; this poses a challenge seeing as the need for effective adaptation measures is urgent.
158. Overall, conventional adaptation measures can be expensive, incapable of adapting to changes and ineffective. Furthermore, projects often address only one part of the problem. Inefficiencies arise from not following a holistic approach and streamlining the various measures to enhance resilience to flood and drought.

Implementation Proposed Adaptation Fund Programme

159. The proposed programme follows a holistic and innovative approach to enhance resilience to flood and drought at the project sites. One of the key elements of the programme is the implementation of the innovative water-filled mobile flood barrier we call SLAMDAM. An analysis was made as part of an assignment by members of the University of Delft in The Netherlands to compare this technology with alternative mitigating measures. Criteria have been formulated, inspired by the OECD (Organization for Economic Cooperation and Development) (1992), for evaluation and comparison of international development projects,

which are: (i) Relevance, (ii) Effectiveness, (iii) Sustainability, (iv) Efficiency and (v) Impact. Each of the criteria has multiple sub-criteria. The outcome of this analysis is included in Table H in Annex 1.

160. The assignment by the University of Delft members showed that the water-filled flood barrier scored the highest compared to the alternative measures. Note that the analyzed mitigation measures are not necessarily mutually exclusive. The programme aims to leverage alternative mitigation measures, such as an FEWS (Flood Early Warning System), complementary to the mobile flood barrier.
161. This is the first time a programme will be implemented using this unique combination of innovative products and services. If successful, this programme could serve as a blueprint for future programmes across Burundi and other developing countries to enhance resilience to both flood and drought. The programme shall explore whether it's advantageous to implement activities in parallel with projects funded from other sources. The precondition in doing so is that the proposed programme shall deliver its outcomes and outputs regardless of the success of the other project(s).

M. Programme sustainability

162. The sustainability of the programme is enabled by a participatory approach promoted throughout all programme activities, which will allow stakeholders such local communities and authorities to build ownership over the project results. It is imperative that roles and responsibilities are clearly defined and agreed upon.
163. The sustainability of the programme is furthermore enabled using tools and technologies that are durable. Subsequently, benefits will be realised over a long period of time well after the programme has come to a closure.
164. The programme shall define the financing mechanism to finance activities after completion of the programme. At the heart of the mechanism is a specification of the costs of upholding the implemented tools, technologies, and practices as part of this programme. Agreements shall be made with institutions to ensure financial resources are available to support activities such as maintenance costs. An agreed financing mechanism must be in place to ensure sustainability of the programme.
165. The programme shall use the ABM methodology to define anticipated and realised ABs from implementing the activities as defined. Using that methodology, the programme sets targets based on the AB-analysis and ensures that relevant stakeholder take ownership of realizing these targets well after the programme has been completed.
166. The programme shall establish an M&E framework that defines processes and people to monitor the results from the implemented activities as part of this programme. The programme shall appoint and train an M&E team to monitor and record the realised ABs. It is imperative that the team comprises of representatives of vulnerable groups such as women and youth. The programme also provides a toolkit to record ABs per flood and drought event and per

period. The ex-post analysis is further enlightened in the ABM methodology and requires data collection through methodologies such as interviews and field visits.

167. All key areas of sustainability are included in the M&E framework being economic, social, environmental, institutional and financial. Specific targets are defined for each area and these will be monitored by the M&E team and evaluated by the installed committee.
168. As part of components 1 and 4, the programme shall establish a knowledge sharing process and a feedback mechanism. These activities ensure that throughout the year, stakeholders can share their experience and the performance of the adaptation tools and technologies. It is imperative to share what went well and what not. Other stakeholders can learn from that and can provide guidance on how to improve. A robust and effective knowledge sharing system and feedback mechanism are essential to make further improve flood and drought resilience and therewith enable sustainability of the programme.
169. Ultimately, the programme shall define what the costs are for an AB. In other words, the programme can define what ABs are realised for the financial investment. In turn, this enables scaling up/replicating programme activities in other regions and countries. Reliable ex-ante analyses can be conducted to indicate what ABs can be expected for investments in the programme activities like this programme.

N. Environmental and social impacts and risks

170. The programme recognizes that with similar initiatives in the water sector, there are inherent environmental and social risks that must be analyzed. The programme analyzes these risks in accordance with the Environmental and Social Policy (ESP) and Gender Policy of the Adaptation Fund. The outcome of the risk analysis clarifies the gender-specific cultural and legal context of the programme.
171. The programme has identified potential environmental and social risks that arise from implementing this programme. The screening process considers all potential direct, indirect, transboundary, and cumulative risks that could result from the proposed programme. The findings of the screening determine the scope of the assessment. The extent and the scale of the assessment will be commensurate with the risks.
172. The programme is classified as a Category C programme meaning that it has no adverse environmental or social impacts. The reasoning behind this categorization is that the aim of the programme is to improve environmental and social impacts using inputs from especially vulnerable groups in target communities. Implementation of adaptation tools and technologies shall consider possible adverse impacts before and during the implementation. The programme shall redesign the adaptation tools and technologies to prevent adverse impacts in case the feasibility study indicates that there are adverse impacts.
173. Despite of the Category C classification, the programme shall identify and assess all environmental and social risks for the full proposal in an open and transparent manner with appropriate consultation. The programme describes the assessment approach and ensures that

it meets the requirements of the policy. The full proposal includes a grievance mechanism that facilitates grievances in a transparent manner. The programme shall also develop a monitoring program commensurate with actions identified in the Environmental and Social Management Plan (ESMP) to ensure that appropriate actions are taken in a timely manner.

174. The result of the screening process is included in below table depicting which environmental and social risks are triggered by the programme and require more detailed environmental and social assessment. The completed checklist furthermore indicates which risks do not require any further assessment to achieve full compliance with the ESP. In case a more detailed assessment is required, the programme shall elaborate on the inherent risks and which measures shall be implemented to realise a managed risk level that is in line with the risk tolerance level. The risk tolerance level includes, at a minimum, mitigating measures that ensure that the programme is in full compliance with the ESP of the Adaptation Fund.

Table 5: Checklist environmental and social risks and compliance with the ESP

Environmental and social principles	Risks triggered by the programme	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
1. <i>Compliance with the Law</i>	Risk that the programme does not comply with applicable domestic and international laws due to lack in (1) capacity or willingness to adhere to laws caused by inadequate expertise, resources to take the necessary actions or control thereof.	N/a	<p>Risk chance Low probability as most programme activities are not bound by laws.</p> <p>Risk potential impact Very high seeing that in adherence to laws can result in a cancelation of the programme.</p> <p>Further assessment and management Additional assessment is needed to describe the legal and regulatory framework for any activity that may require prior permission. Actions shall be defined how to comply with these laws</p>
2. <i>Access and Equity</i>	Risk that the programme does not provide fair and equitable access to benefits due to an improper process to allocate and distribute programme benefits caused by project implementation arrangements that are not inclusive.	<p>Risk chance Very low probability as most benefits cannot be allocated to specific groups.</p> <p>Risk potential impact High seeing as this could impede access of any group to the essential services and rights.</p> <p>No further assessment The intervention logic of the programme is to provide benefits to the vulnerable groups, with fair and equitable access to activities, equipment, resources, and training throughout the planning and execution phases. The programme involves marginalized groups and sets</p>	N/a

		benefit targets for these groups and monitors realisation of benefits. The inherent risk is low and measures are already in place to ensure compliance.	
3. <i>Marginalized and Vulnerable Groups</i>	Risk that the programme imposes disproportionate adverse impacts on marginalized and vulnerable groups due to a lack of consideration caused by improper identification of these groups or inadequate involvement in the programme.	N/a	<p>Risk chance Very low probability as the programme aims to help marginalized and vulnerable groups improve their living conditions and quality of life.</p> <p>Risk potential impact High seeing as adverse impacts would deteriorate the wellbeing of marginalized and vulnerable groups and exacerbate the equality gaps.</p> <p>Further assessment and management Inherent risk is low, yet further assessment helps clarify possible impacts on marginalized and vulnerable groups. The programme shall describe characteristics of marginalized groups and possible adverse impacts. The programme involves these groups in consultations and the co-design process.</p>
4. <i>Human Rights</i>	Risk that the programme does not respect international human rights due to a shortcoming in creating awareness in the programme caused by not explicitly discussing human rights with stakeholders during consultations.	N/a	<p>Risk chance Low probability as the programme addresses human rights during consultations.</p> <p>Risk potential impact Very high seeing as human rights violations are detrimental for the wellbeing of people whom the programme is trying to help. Violations can also lead to a cancellation of the programme.</p>

			<p>Further assessment and management The programme shall identify relevant human rights issues for Burundi that are cited in the Human Rights Council Special Procedures. Human Rights issues are explicitly part of the consultations. The programme shall ensure compliance with Universal Declaration of Human Rights (UDHR).</p>
<p>5. <i>Gender Equity and Women’s Empowerment</i></p>	<p>Risk that women and men (1) don’t have equal opportunities, (2) receive comparable benefits or (3) suffer adverse effects disproportionately due to improper identification of opportunities, benefits adverse effects per gender caused by not involving either gender adequately in the programme.</p>	<p>N/a</p>	<p>Risk chance Very low probability as the programme aims to help women improve their living conditions and quality of life. The programme activities often lack in the ability to discriminate either gender.</p> <p>Risk potential impact High seeing as adverse impacts could deteriorate the wellbeing of women and exacerbate the gender gap.</p> <p>Further assessment and management The chance of an issue is very low, yet further assessment helps clarify how the programme prevents excluding or hampering of a gender group and exacerbating or maintaining of the gender gap. The assessment for this principle includes: (1) An analysis of the legal and regulatory context, (2) ensuring equal participation in the programme and (3) adverse impacts per gender and corresponding mitigating measures. The programme ensures involvement of all genders in consultations and the co-design process.</p>

<p>6. <i>Core Labour Rights</i></p>	<p>Risk that the programme does not meet core labour standards as identified by the International Labour Organization (ILO) due to lack in capacity or willingness to implement ILO standards caused by not involving experts or assigning responsibilities when designing and implementing the programme.</p>	<p>N/a</p>	<p>Risk chance Very low probability as the programme has relatively little involvement of local labour throughout the programme, even though the programme aims to enhance job security and the economy.</p> <p>Risk potential impact High seeing as adverse impacts could deteriorate the rights of labourers. Violation of ILO standards can lead to cancellation of the programme.</p> <p>Further assessment and management Despite that the risk is chance of an issue is low, an assessment is needed to identify how the programme could violate ILO standards and what measures are in place to prevent that from happening. ILO core labour standards shall be incorporate in the design and implementation of the programme.</p>
<p>7. <i>Indigenous Peoples</i></p>	<p>Risk that the programme is 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 due to lack in capacity or willingness to implement these rights caused by not involving experts or assigning responsibilities when designing and implementing the programme.</p>	<p>Risk chance Very low probability as indigenous peoples are hardly present in the programme implementation area.</p> <p>Risk potential impact Medium seeing as the programme activities to a great extent cannot lead to adverse impacts for indigenous people.</p> <p>No further assessment The programme identifies indigenous people and involves them in the consultations and programme activities.</p>	<p>N/a</p>

		Monitoring activities will be implemented to ensure rights are not violated.	
8. <i>Involuntary Resettlement</i>	Risk that the programme leads to the need for involuntary resettlement due to loss of jobs or inaccessibility to homes caused by implementation of programme activities that have adverse impacts on livelihoods and access to homes.	<p>Risk chance Very low probability as the programme explicitly aims to prevent the need of resettlement by enhancing resilience to floods and drought.</p> <p>Risk potential impact Medium seeing as there are programmes in place to support people in resettling.</p> <p>No further assessment No need for a further assessment seeing as the chance of an issue is very low and there are already measures in place to manage issues should these occur. As part of the programme, modelling will be conducted to analyse flood and drought events and their impact on communities.</p>	N/a
9. <i>Protection of Natural Habitats</i>	Risk that the programme involves unjustified conversion or degradation of critical natural habitats due to change in landscape caused by the implementation of programme activities such as flood barriers.	<p>Risk chance Very low probability as the programme explicitly aims to prevent damage caused by flood and drought events.</p> <p>Risk potential impact High seeing damage to natural habitats might be difficult to restore.</p> <p>No further assessment No need for a further assessment seeing as the chance of an issue is very low and the programme aims to realise the opposite by protecting natural habitats from floods and drought. The programme</p>	N/a

		will identify natural habitats and monitor benefits or adverse impacts.	
10. <i>Conservation of Biological Diversity</i>	Risk that the programme leads to significant or unjustified reduction or loss of biological diversity or the introduction of known invasive species due to changes in the landscape or water management caused by the implementation of programme activities such as flood barriers.	<p>Risk chance Very low probability as the programme explicitly aims to prevent damage caused by flood and drought events therewith protecting biodiversity.</p> <p>Risk potential impact High seeing damage to natural habitats might be difficult to restore.</p> <p>No further assessment No need for a further assessment seeing as the chance of an issue is very low and the programme aims to realise the opposite by protecting the biological diversity from floods and drought. The programme shall substantiate by identifying (1) biological diversity, (2) lack in potential of a significant or unjustified reduction or loss of biological diversity and (3) lack in potential to introduce known invasive species.</p>	N/a
11. <i>Climate Change</i>	Risk that the programme results in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change due to lack in climate considerations in programme activities (e.g. manufacturing of flood barriers) caused by lack in capacity or willingness to identify adverse impacts or implement mitigating measures.	N/a	<p>Risk chance Low seeing as the programme aims to implement tools and technologies that are driven by clean energy.</p> <p>Risk potential impact High seeing as an issue might exacerbate the negative impacts of climate change.</p> <p>Further assessment and management</p>

			The programme shall identify activities and the possibility that these result in negative impacts on climate change. Specifically, the programme will explore manufacturing processes of technologies and define mitigation measures.
12. <i>Pollution Prevention and Resource Efficiency</i>	Risk that the programme does not meet international standards for maximizing energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants due to lack in capacity or willingness to identify standards or implement mitigating measures caused by improper design of the programme assigning responsibilities on the subject matter.	N/a	<p>Risk chance Low seeing as the programme aims to implement tools and technologies that are climate friendly.</p> <p>Risk potential impact High seeing as an issue might lead to excessive costs or pollution negatively impacting the environment or people.</p> <p>Further assessment and management The programme assesses and explains how it will minimize in a reasonable and cost-effective way the resources that will be used during implementation especially during the production process. The programme will do the same for prevention of waste and pollution.</p>
13. <i>Public Health</i>	Risk that the programme leads to significant negative impacts on public health due to not adequately analyzing determinants of health or implementing mitigating measures caused by improper design of the programme or assigning responsibilities on the subject matter	<p>Risk chance Very low probability as the programme explicitly aims to improve public health by reducing vulnerabilities to flood and drought.</p> <p>Risk potential impact High seeing as the population could suffer injuries or health issues</p> <p>No further assessment</p>	N/a

		No need for a further assessment seeing as the chance of an issue is very low and the programme aims to protect people from floods and drought. The programme shall complete a health impact checklist.	
14. <i>Physical and Cultural Heritage</i>	Risk that the programme leads to 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 due to a lack of consideration caused by improper identification of physical and cultural heritage.	<p>Risk chance Very low probability as there is hardly any presence of cultural heritage in or near the programme.</p> <p>Risk potential impact Medium seeing as the population could suffer injuries or health issues</p> <p>No further assessment No need for a further assessment seeing as the chance of an issue is very low and the potential impact us medium. The programme shall identify the presence of cultural heritage during consultations.</p>	N/a
15. <i>Lands and Soil Conservation</i>	Risk that the programme does not promote soil conservation and leads to degradation or conversion of productive lands or land that provides valuable ecosystem services due to changes in the landscape or water management caused by the implementation of programme activities such as flood barriers.	<p>Risk chance Very low probability as the programme explicitly aims to prevent degradation or conversion of productive lands that provides valuable ecosystem services.</p> <p>Risk potential impact High seeing degradation or conversion of productive lands or land could damage the ecosystem and livelihoods.</p> <p>No further assessment No need for a further assessment seeing as the chance of an issue is very low and the programme aims to realise the opposite by protecting productive lands</p>	N/a

		or land. The programme shall identify the presence of fragile soils and productive land that provides valuable ecosystem services within the programme area.	
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PART III: IMPLEMENTATION ARRANGEMENTS

- A. Describe the arrangements for project / programme management at the regional and national level, including coordination arrangements within countries and among them. Describe how the potential to partner with national institutions, and when possible, national implementing entities (NIEs), has been considered, and included in the management arrangements.

- B. Describe the measures for financial and project / programme risk management.

- C. Describe the measures for environmental and social risk management, in line with the Environmental and Social Policy of the Adaptation Fund.

- D. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.

- E. Include a results framework for the project / programme proposal, including milestones, targets, and indicators.

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

<i>Project Objective(s)</i> ³³	<i>Project Objective Indicator</i>	<i>Fund Outcome</i>	<i>Fund Outcome Indicator</i>	<i>Grant Amount (USD)</i>
Project Outcome(s)	Project Outcome Indicator(s)	Fund Output	Fund Output Indicator	Grant Amount (USD)

³³ The AF utilized OECD/DAC terminology for its results framework. Project proponents may use different terminology but the overall principle should still apply

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G. Include a detailed budget with budget notes, broken down by country as applicable, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs.

H. Include a disbursement schedule with time-bound milestones.

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

A. Record of endorsement on behalf of the government³⁴ *Provide the name and position of the government official and indicate date of endorsement for each country participating in the proposed project / programme. Add more lines as necessary. The endorsement letters should be attached as an annex to the project/programme proposal. Please attach the endorsement letters with this template; add as many participating governments if a regional project/programme:*

<i>(Enter Name, Position, Ministry)</i>	<i>Date: (Month, day, year)</i>
<i>(Enter Name, Position, Ministry)</i>	<i>Date: (Month, day, year)</i>
<i>(Enter Name, Position, Ministry)</i>	<i>Date: (Month, day, year)</i>

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 *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person’s name, telephone number and email address*

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 (.....list here.....) 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.

Name & Signature
Implementing Entity Coordinator

Date: *(Month, Day, Year)*

Tel. and email:

Project Contact Person:

Tel. And Email:



ADAPTATION FUND

Letter of Endorsement by Government

[Government Letter Head]

[Date of Endorsement Letter]

To: The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

Subject: Endorsement for [Title of Project/Programme]

In my capacity as designated authority for the Adaptation Fund in [country], I confirm that the above (select national or regional) project/programme proposal is in accordance with the government's (select national or regional) priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in the (select country or region).

Accordingly, I am pleased to endorse the above project/programme proposal with support from the Adaptation Fund. If approved, the project/programme will be implemented by [implementing entity] and executed by [national or local executing entity].

Sincerely,

[Name of Designated Government Official]
[Position/Title in Government]

Annex 1: Additional tables to be used in the Full Proposal

Table A.: Benefits of the project

Project outcome	Economic benefits	Social benefits	Environmental benefits
<p>Outcome 1.1: <i>Increased use of effective information technology by stakeholders.</i></p>	<ul style="list-style-type: none"> Enhanced understanding on how to extract the most economic value of adaptation practices, tools and technologies. Decrease in financial damages due to timely and effective disaster response enabled by information services. Increase in crops and livestock production through smart agriculture and software/apps. 	<ul style="list-style-type: none"> Information services (e.g. early warning) will prevent human loss, injuries and diseases. Protecting social assets through the implementation of information services. Enhanced livelihoods by effective disaster management through information services. The information will provide input to the population to adapt agricultural practices. 	<ul style="list-style-type: none"> A better understanding of how the environment is impacted by floods and drought and how to protect the environment. More efficient and effective utilization of natural resources through information services.
<p>Outcome 2.1: <i>Increased uptake and usage of concrete and innovative flood adaptation actions.</i></p>	<ul style="list-style-type: none"> Prevention of direct and indirect financial damages caused by flooding. Increase in crops and livestock production by preventing inundation of (agricultural) land. Creation of new jobs to support flood disaster management. 	<ul style="list-style-type: none"> Reduced loss of human lives, injuries and diseases. Improved quality of life through increase in jobs and income. Reducing social unrest, conflicts and, migration of community members because their livelihoods were destroyed by floods. Protection of damages to social assets such as schools and healthcare facilities. 	<ul style="list-style-type: none"> Protection of biodiversity and (agricultural) land from flood damages. Prevention of land erosion caused by flood events.

<p>Outcome 2.2: <i>Increased uptake and usage of concrete and innovative drought adaptation actions.</i></p>	<ul style="list-style-type: none"> • Increase in crops and livestock production through enhanced water availability and water harvesting and irrigation structure. • Creation of new businesses due to increase in arable land. • Creation of new jobs to support drought disaster management. 	<ul style="list-style-type: none"> • Enhancing of food and water security for the drought-affected populations. • Improved quality of life through increase in jobs and income. • Increase availability of drinkable water. • Reducing social unrest, conflicts and, migration of community members seeking water and other sources of livelihoods 	<ul style="list-style-type: none"> • Enhanced water availability for human and livestock populations and arable land. • Increase in efficient usage of water. • Improved protection and restoration of ecosystems through the uptake in availability of water. • Improved land management/conservation infrastructure, leading to reduced soil loss and increased quantity of agricultural produce.
<p>Outcome 3.1: <i>Flood and drought resilience of key stakeholders at regional, national and local levels strengthened.</i></p>	<ul style="list-style-type: none"> • Improved capabilities to create economic value from flood and drought resilient adaptation practices, tools and technologies. 	<ul style="list-style-type: none"> • Flood and drought management plans bring together various (public and private) organisations at all levels of society. 	<ul style="list-style-type: none"> • Equal distribution of land and water to support the environment and the population.
<p>Outcome 3.2: <i>Partnerships for flood and drought management at regional, national and local levels strengthened.</i></p>	<ul style="list-style-type: none"> • Creation of new jobs by intensified collaboration between different organisations and communities. • Improved value chain related to crops and livestock products to increase economic value. 	<ul style="list-style-type: none"> • The participation and involvement of people will contribute to develop long-term sustainable products and services which will be beneficial in increasing personal and national growth. 	<ul style="list-style-type: none"> • Improved “checks and balances” to ensure protection, restoration and management of the environment.
<p>Outcome 4.1: <i>Knowledge and awareness on flood and drought risks management is increased.</i></p>	<ul style="list-style-type: none"> • Increase in availability of national expertise decreases the costs for external knowhow. 	<ul style="list-style-type: none"> • Adaptive capacity of communities to flood. and drought increased. • General raising of awareness of impact of climate change to the 	<ul style="list-style-type: none"> • Improved understanding amongst various organisations and communities on how to protect the environment.

		<p>community and the need for an enhanced role by the community</p> <ul style="list-style-type: none">• Strengthening the active participation of vulnerable populations in decisions linked to climate change.	
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Table B.: Programme alignment with (sub-)national strategies, plans and programmes

Strategy/plan/programme	Year published	Priorities	Programme compliance/contribution
1. Strategic plan: National Action Plan for Adaptation (NAPA) ³⁵	2007	<ul style="list-style-type: none"> • Control the river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura. • Popularise short cycle and dryness resistant food crops. • Popularise rainwater harvesting techniques for agricultural or domestic use. • Train and inform the decision makers and other partners, including the local communities on the methods of adaptation to climate variability. • Improve seasonal early warning climate forecasts. 	<ul style="list-style-type: none"> • Prevent flooding and control water availability in Bujumbura Mairie and Rural Provinces. • Enhance smart agriculture practices, tools and technologies. • Implement water harvesting structures to harness flood water. • Capacity building of different stakeholder groups to improve skillset to enhance resilience to floods and drought using innovative adaptation practices, tools and technologies. • Implement information services including early warning systems.
2. Strategic plan: National Climate Change Strategy and Action Plan ³⁶	2012	<ul style="list-style-type: none"> • Integrate disaster risk reduction into policies and plans for sustainable development. • Develop and strengthen institutions, mechanisms and capacities to build resilience to hazards. • Systematically consider risk reduction in emergency preparedness/response/recovery activities. 	<ul style="list-style-type: none"> • Innovative adaptation practices, tools and technologies (e.g. mobile flood barriers) will be integrated into plans and policies. • Capacity building of institutions and communities to build resilience to floods and drought supported by mechanisms (processes, toolkits etc.).

³⁵ Burundi Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

³⁶ Nile Basin Initiative (2013): Climate Change Strategy. www.nilebasin.org/index.php/media-center/publications/doc_down-load/104-nbi-climate-change-strategy.

			<ul style="list-style-type: none"> • Risk appetite is defined and adaptive measures and practices to reduce disaster risks are included in plans.
<p>3. Strategic plan: Nationally Determined Contributions (NDC)³⁷ / National Strategy and Action Plan on Climate Change (2012)</p>	<p>2021</p>	<p><i>Climate risk adaptation and management.</i></p> <ul style="list-style-type: none"> • Integrated water resources management by a small hydrological unit. • Integrated management of climate risk and forecasts over time (by means of probabilities and forward-looking studies) so as to be able to take action in advance. • Protection of aquatic and land-based ecosystems. • Coaching of the population to develop their resilience to climate change. • Establishment of functional monitoring and evaluation mechanisms for climate change, as well as knowledge management and information mechanisms. • Promotion of climate-smart agriculture (agrometeorology). 	<p><i>Climate risk adaptation and management.</i></p> <ul style="list-style-type: none"> • A water harvesting structure will be implemented to harness water upstream to enhance water security. • Information services will be implemented to analyse/forecast flood and drought risks that triggers response strategies/actions. • Flood events will be prevented using a mobile flood barrier to protect ecosystems. • Capacity building of institutions and the populations will be held to develop resilience to climate change in the water sector. • A monitoring and evaluation and knowledge sharing system and tools will be implemented. • Climate-smart practices, tools and technologies will be implemented to enhance crops production.
		<p><i>Capacity-building, knowledge management and communication.</i></p> <ul style="list-style-type: none"> • Enhancement of data and information management and distribution mechanisms. • Strengthening of the information and data communication and exchange system. 	<p><i>Capacity-building, knowledge management and communication.</i></p> <ul style="list-style-type: none"> • Weather data will be collected and information management will be standardised and centralised.

³⁷ Republic of Burundi (2018). Nationally Determined Contribution. Available via <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Burundi%20First/CPDN%20BURUNDI.pdf>

		<ul style="list-style-type: none"> Reinforcement of climate change impact tracking systems by means of observations and investigations. 	<ul style="list-style-type: none"> Data and information communication will be standardised and centralised supported by toolkits and information services. Monitoring and evaluation activities will be embedded to keep track of the damages caused by floods and drought.
<p>4. Strategic plan: Burundi national development plan NDP Burundi 2018-2027.³⁸</p>	2018	<ul style="list-style-type: none"> Strengthening the economy of Burundi by enhancing national productivity. Strengthening the economy of Burundi by creation of new jobs. 	<ul style="list-style-type: none"> Arable land will be protected from floods to increase the potential to grow crops. Water will be harnessed during flood season and for irrigation purposes and as drinking water increasing crops and livestock products. Smart agriculture practices will be implemented to realise the highest yield. Linkages will be made with buyers to increase sales and create new jobs.
<p>5. Strategic plan: Third national communication on climate change (TNCCC).³⁹</p>	2019	<ul style="list-style-type: none"> Capacity building in weather, climate and hydrological modelling and to cover all aspects of agro-meteorological assistance. Promote, encourage and support community adaptation strategies related to agriculture and livestock to cope with climate change. Integrate climate and environmental issues into water and resources sanitation improvement strategies/plans and develop 	<ul style="list-style-type: none"> Implementation of information services including hydrological modelling software and capacity building of local staff. Implementation of knowledge management framework to ensure stakeholder groups have access to and can disseminate information on adaptation practices, tools and technologies. Implementation of smart agriculture practices and development of flood and drought

³⁸ <https://www.presidence.gov.bi/wp-content/uploads/2018/08/PND-Burundi-2018-2027-Version-Finale.pdf>

³⁹ <https://unfccc.int/sites/default/files/resource/Burundi%20TNC%20executive%20summary.pdf>

		<p>risk assessments and measures for emergency situations.</p>	<p>adaptation plans to adapt agriculture and livestock production to climate change.</p> <ul style="list-style-type: none"> • Develop flood and drought risk assessments and implement adaptation practices, tools and technologies and amend strategies and plans.
<p>6. Strategic plan: National Strategy and Action Plan to Combat Soil Degradation 2011-2016.⁴⁰</p>	2011	<ul style="list-style-type: none"> • Improved fertility of agricultural soils and ecological conditions in degraded areas. • Institutional and community capacity building in soil management. 	<ul style="list-style-type: none"> • Information services will be implemented to support soil management. • Agricultural land will be protected from floods to increase the potential to grow crops. • Water will be harnessed during flood season and to improve fertility of land. • Smart agriculture practices and capacity building will be conducted to enhance soil management. • Implementation of knowledge management framework to ensure stakeholder groups have access to and can disseminate information on soil management.
<p>7. Strategic plan: National Water Strategy 2011 – 2020.⁴¹</p>	2012	<ul style="list-style-type: none"> • Prevention and management of water-related disasters and protection of Water Resources. • Instruments for the Integrated Management of Water Resources. • Cooperation for the management of shared water resources with involvement of women 	<ul style="list-style-type: none"> • Implementation of innovative adaptation practices, tools and technologies to enhance resilience to floods and drought including information services and flood barriers. • Development of flood and drought management plans and creating MOUs/partnership agreements.

⁴⁰ http://obpe.bi/images/pdf/Strategie_Degration_des_terres.pdf

⁴¹ https://www.pseau.org/outils/ouvrages/meeatu_strategie_nationale_de_l_eau_2011_2020_1970.pdf

		and special consideration for vulnerable groups.	<ul style="list-style-type: none"> • Ensuring involvement of women in flood and drought risk management activities. Specific sections in the flood and drought management plans on how to protect vulnerable groups. • Implementation of knowledge management framework to ensure stakeholder groups have access to and can disseminate information on water management.
8. Strategic plan: National Agriculture Strategy 2018-2027. ⁴²	2018	<ul style="list-style-type: none"> • Rational and optimal exploitation of natural resources, in particular land and water resources. • Development of resilience to climate change. • Processing and preservation of food, pastoral and fishery products. • Capacity building of institutional and organizational structures. 	<ul style="list-style-type: none"> • Implementation of innovative adaptation practices, tools and technologies (e.g. information services and flood barriers) to improve access to natural resources. These solutions also enhance resilience to climate change-induced floods and drought. • Implementation of smart agricultural practices and a solar powered cold storage unit to improve production and preservation of food. • Capacity building of institutions and the populations will be held to develop resilience to climate change in the water sector.
9. Strategic plan: Technology Needs Assessment – Adaptation. ⁴³	2016	<p>Water Resources sector</p> <ul style="list-style-type: none"> • Monitoring water quantities. • Harnessing rainwater • Control of the rain dynamics. <p>Agriculture and Livestock sector</p>	<ul style="list-style-type: none"> • Implementation of hard- and software to monitor weather/hydrodynamic data. • The implementation of water harnessing infrastructure using innovative technologies.

⁴² <http://extwprlegs1.fao.org/docs/pdf/Bur190783.pdf>

⁴³ https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNA_key_doc/e2a748d4d7fb46a886411a2739cf72d7/eb976df133a34e74b758e3e22fd15490.pdf

		<ul style="list-style-type: none"> • Soil conservation systems. • Development of the short cycle rice variety • Community early warning systems 	<ul style="list-style-type: none"> • The implementation of tools, technologies to control rain dynamics such as mobile flood barriers. • Agroecosystem management practices will be to increase agricultural productivity and food security through better to conservation of soil and water resources and crops management. • The programme shall implement flood and drought early warning systems.
10. Strategic plan: Technology Action Plan – Adaptation. ⁴⁴	2018	<ul style="list-style-type: none"> • As per above 	<ul style="list-style-type: none"> • As per above
11. Programme: Climate proofing food production investments in Imbo and Moso basins in the Republic of Burundi. ⁴⁵	2020	<ul style="list-style-type: none"> • Transforming current agro-ecological land and water management practices in the upper, middle, and lower Imbo and Moso catchments towards more sustainable and productive land use practices. • Build farmers' resilience to climate change in the upper, middle, and lower Imbo and Moso catchments and to increase agricultural productivity and food security through adoption of better agroecosystem management practices to conserve soil and water resources. 	<ul style="list-style-type: none"> • Floods will be prevented and water will be stored in a water harvesting structures to enhance water security near the Imbo catchment. • Agroecosystem management practices will be implemented at the Imbo catchment to increase agricultural productivity and food security through better to conservation of soil and water resources.
12. Programme: Community Disaster Risk Management in Burundi (<i>Bugesera</i> ,	2012	<ul style="list-style-type: none"> • Early warning systems (on climate change induced risks including new or emerging vulnerabilities and hazards) established for communities. 	<ul style="list-style-type: none"> • Implementation of information services including flood and drought early warning systems.

⁴⁴ https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNA_key_doc/faba3d9fb058453bb241a7c2b4d0c640/3239bd8f111e4c5b806077e759c98ad0.pdf

⁴⁵ <https://www.greenclimate.fund/sites/default/files/document/sap017-ifad-burundi.pdf>

<p><i>Mumirwa and Imbo Lowlands</i> regions)⁴⁶</p>		<ul style="list-style-type: none"> • Livelihoods and infrastructure risk assessment undertaken with gender-focused analysis. • Policy actions undertaken on the basis of anticipated climate change projections. • Flood Control in Bujumbura. 	<ul style="list-style-type: none"> • Adaptation benefits mechanism is developed and applied to perform flood and drought risk analysis and interventions are designed to support vulnerable groups including women and children. • The impact of climate change on flood and drought risks are analysed and corresponding adaptation actions are designed and incorporated in policies and plans. • Flood control structures will be implemented in Bujumbura to enhance resilience to floods.
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⁴⁶ <https://www.thegef.org/projects-operations/projects/4990>

Table C.: Overview Adaptation Fund (AF) principles and corresponding national standards and compliance by project

AF Principle	National text enacting the standard	Standard	Project relevance and compliance
1. <i>Compliance with the Law</i>	Law No. 1/10 of June 30, 2000 on the Environmental Code of the Republic of Burundi. ⁴⁷	When developments, works or facilities risk harming the environment, the code obliges the petitioner or contracting authority to draw up and submit to the administration of the environment an impact study making it possible to assess the direct or indirect impacts of the project on the ecological balance, the environment and the quality of life of the population and the impacts on protection.	<ul style="list-style-type: none"> • Activities 2.1.2.1., 2.1.3.1., 2.1.3.2., 2.2.1.1, 2.2.3.2, 2.2.3.3., 2.2.3.5: Construction of adaptation technologies (e.g. mobile flood barriers, storage facilities, irrigation system) are subject to Environmental Impact Assessments (EIAs) to ensure that all potential risks are managed according to the national law and safeguards standards. • The project shall carry out an ESIA <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
	Decree No. 100/22 of October 07, 2010 on measures for the application of the environmental code in relation to the environmental impact study procedure. ⁴⁸	This decree, in its articles 4 and 5, classifies projects into three categories: (i) projects that must be submitted to an environmental impact study regardless of the cost of their implementation, (ii) projects that are subject to an environmental impact study when the Ministry of the Environment considers that the characteristics, location or even the scale of the planned work are likely to affect the environment and (iii) projects which should not be subject to EIA	<ul style="list-style-type: none"> • Project initiation: During the project initiation phase, the project shall carry out an ESIA. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
2. <i>Access and Equity</i>	Law No. 1/02 of March 26, 2012 on the Water	Avoid waste of water and in a watershed, the different uses of	<ul style="list-style-type: none"> • Activity 1.1.1.3: Information services are developed to enable efficient use of water and prevent waste.

⁴⁷ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁴⁸ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

	<p>Code in Burundi and its implementing texts.⁴⁹</p>	<p>water are considered together and each use takes into account its effects on the others.</p>	<ul style="list-style-type: none"> • Activities 3.2.1.2: Multi-sectoral/stakeholder agreements and platforms are developed to coordinate usage of water. • Activities 4.1.1.2: Knowledge sharing framework/platforms to disseminate/share knowledge on how water is used and the effects of adaptation practices, tools and technologies. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
	<p>Decree No. 100/189 of August 25, 2014 on the procedures for determining and installing the protection perimeters of water catchments intended for human consumption.⁵⁰</p>	<p>The development of the perimeter is subject to the prior obtaining of competent authorisation, whatever the type of protection perimeter (article 3). Authorizations are issued by (i) the Minister in charge of water if the catchment is equipped with a water supply system and (ii) by the municipal administrator if the catchment does not include an adduction system, (articles 4 and 12). Any establishment of an immediate protection perimeter is preceded by the allocation of fair and prior compensation to owners and holders of other land rights on the non-state part of the perimeter in question, in accordance with the provisions of the land code in</p>	<ul style="list-style-type: none"> • Activity 2.2.3.1: A water harvesting and storage infrastructure will be constructed that shall not obstruct a minimum flow or volume of water guaranteeing the life, movement and reproduction of the species that inhabit the water. • Activities 2.1.2.1 and 2.1.3.1: Ground works will be performed and flood barriers will be deployed taking into consideration water supply for human consumption. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>

⁴⁹ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁰ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

		expropriation in the public interest (Article 10).	
3. <i>Marginalized and Vulnerable Groups</i>	Article 22 of the Constitution of 18 March 2005. ⁵¹	All citizens shall be equal before the law, which shall guarantee them equal protection. No-one may be discriminated against on the grounds of origin, race, ethnicity, gender, colour, language, social situation, religious, philosophical or political convictions or for being a carrier of HIV/AIDS or any other incurable illness.	<ul style="list-style-type: none"> • Activity 3.1.1.1: Flood and drought management plans reflect the roles and responsibilities of the people involved. The project ensures that the plans don't allow for any form of discrimination. • Activities 3.1.2.1, 3.1.2.4 and 3.1.2.5: Capacity building and training of various stakeholder groups includes representatives of various groups without any form of discrimination. • Activity 3.2.1.2: Flood and drought management multi-sectoral/stakeholder agreements include sections about prevention of discrimination. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
4. <i>Human Rights</i>	Article 52 of the Constitution of 18 March 2005. ⁵²	Everyone is entitled to the enjoyment of the economic, social and cultural rights indispensable to their dignity and freedom of personal development, as a result of the national effort in this regard bearing in mind the country's resources".	<ul style="list-style-type: none"> • Activity 3.1.1.1: Flood and drought management plans reflect the roles and responsibilities of the people involved. The project ensures that there is no discrimination in the plans. • Activities 3.1.2.1, 3.1.2.4 and 3.1.2.5: Capacity building and training of various stakeholder groups includes representatives of various groups without any form of discrimination. • Activity 3.2.1.2: Flood and drought management multi-sectoral/stakeholder agreements include sections about prevention of discrimination.

⁵¹ https://tbinternet.ohchr.org/_layouts/15/treatybodyexternal/Download.aspx?symbolNo=E/C.12/BDI/1&Lang=en

⁵² https://tbinternet.ohchr.org/_layouts/15/treatybodyexternal/Download.aspx?symbolNo=E/C.12/BDI/1&Lang=en

			The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]
5. <i>Gender Equality and Women's Empowerment</i>	National Gender Policy (NGP), 2012–2025, Ministère de la Solidarité Nationale, des Droits de la Personne Humaine et du Genre (2011)	The 2012–2025 NGP and accompanying action plan sets out to: <ul style="list-style-type: none"> Facilitate the creation of a sociocultural, legal, economic, political, and institutional environment conducive to the achievement of gender equality. Promote the mainstreaming of gender into development interventions in all areas. Strengthen equitable access of women, men, and adolescents to social services. 	<ul style="list-style-type: none"> Activity 3.1.1.1: Flood and drought management plans reflect the roles and responsibilities of the people involved. The project ensures that the interest of women will be considered when implementing flood and drought adaptation. Activities 3.1.2.1, 3.1.2.4 and 3.1.2.5: Capacity building and training of various stakeholder groups includes a substantial number of women who shall participate. Activity 3.2.1.2: Flood and drought management multi-sectoral/stakeholder agreements include sections about involvement of women where relevant. The aim is to have women in higher functions with regards to flood and drought adaptation. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
6. <i>Core Labour Rights</i>	Decree Law No. 1/037 of 07/07/1993 revising the labor code of the Republic of Burundi. ⁵³	Section 146 of Part 6 on occupational safety and health provides that “employers shall be required to comply with the provisions in force regarding the hygiene and safety of workers, the organisation and operation of corporate medical and health services, and special working	<ul style="list-style-type: none"> Activity 3.1.1.1: Flood and drought management plans reflect the roles and responsibilities of the people involved. The project ensures that vulnerable groups such as women will benefit from flood and drought adaptation. Activities 3.1.2.1, 3.1.2.4 and 3.1.2.5: Capacity building and training of various stakeholder groups includes labour rights.

⁵³ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

		conditions for pregnant women and young people”.	<ul style="list-style-type: none"> • Activity 3.2.1.2: Flood and drought management multi-sectoral/stakeholder agreements include sections about labor rights where relevant. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
7. <i>Indigenous Peoples</i>	The Constitution of the Government of Burundi.	Burundi has no specific legislation addressing the situation of the Twa, and the main legal reference for their rights is the current Constitution, which was approved by popular referendum in 2005. The Constitution recognizes the ethnic diversity of Burundi and includes in several of its articles the principle of ethnic quotas and co-optations to reflect this diversity and ensure the participation of the three ethnic groups. At the same time it prohibits any form of exclusion based on ethnicity or regionalism. ⁵⁴	<ul style="list-style-type: none"> • Activity 3.1.1.1: Flood and drought management plans reflect the roles and responsibilities of the people involved. The project considers the different ethnic groups when implementing flood and drought adaptation. • Activities 3.1.2.1, 3.1.2.4 and 3.1.2.5: Capacity building and training of various stakeholder groups considers participation of the various ethnic groups. • Activity 3.2.1.2: Flood and drought management multi-sectoral/stakeholder agreements include sections about involvement of the various ethnic groups where relevant. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
8. <i>Involuntary Resettlement</i>	The Land Code of the Republic of Burundi, Law No. 01/008 of 01/09/1986. ⁵⁵	The law provides the procedure for resettlement. Responsibility for resettlement lies with the Ministry of Water, Environment, Land and Urban Planning (MEEATU), but if	<ul style="list-style-type: none"> • Activities 2.1.1.1 and 2.2.1.1: Development of flood and drought scenarios takes into consideration settlements.

⁵⁴ <https://www.ifad.org/documents/38714170/40224460/burundi.pdf/969773f0-9429-49d3-bccf-d02d4cbcdac4?t=1651742303327>

⁵⁵ <https://esa.afdb.org/sites/default/files/MULTINATIONAL%20BURUNDI-TANZANIE-RUMONGE-BUJUMBURA%20%20ROAD%20SECTION%20RAP%20%20%204th%20July%202018%20%282%29%20%281%29.pdf>

		<p>land is in a wetland, the responsibility lies with the Ministry of Agriculture and Livestock.</p>	<ul style="list-style-type: none"> • Activities 2.1.2.1., 2.1.3.1., 2.1.3.2., 2.2.1.1, 2.2.3.2, 2.2.3.3., 2.2.3.5: In case construction of adaptation technologies (e.g. mobile flood barriers, storage facilities, irrigation system) require resettlements, the project will follow the right procedure with appropriate authorization. • Activity 3.1.1.2: Flood and drought management plans consider resettlement plans and strategies. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
	<p>AFRICAN DEVELOPMENT BANK OP. 4.12 (INVOLUNTARY RESETTLEMENT).⁵⁶</p>	<p>Any development project should avoid or minimize involuntary resettlement and where this is not feasible, it should assist displaced persons in improving or at least resorting their livelihoods and living standards in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.</p>	<ul style="list-style-type: none"> • Activities 2.1.1.1 and 2.2.1.1: Development of flood and drought scenarios takes into consideration settlements with an aim to minimize involuntary resettlement. • Activities 2.1.2.1., 2.1.3.1., 2.1.3.2., 2.2.1.1, 2.2.3.2, 2.2.3.3., 2.2.3.5: In case construction of adaptation technologies (e.g. mobile flood barriers, storage facilities, irrigation system) require resettlements, the project aims to minimize involuntary resettlement. • Activity 3.1.1.2: Flood and drought management plans aim to minimize involuntary resettlement. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
	<p>Law No. 1/10 of May 30, 2011 on the creation</p>	<p>Protected areas must be considered in the overall</p>	<ul style="list-style-type: none"> • Activities 2.1.1.1 and 2.2.1.1: Development of flood and drought scenarios takes into consideration

⁵⁶ <https://esa.afdb.org/sites/default/files/MULTINATIONAL%20BURUNDI-TANZANIE-RUMONGE-BUJUMBURA%20%20ROAD%20SECTION%20RAP%20%20%204th%20July%202018%20%282%29%20%281%29.pdf>

9. <i>Protection of Natural Habitats</i>	and management of protected areas in Burundi. ⁵⁷	development plan and their management must go hand in hand with the development of the human environment along the river, and the participatory management of protected areas must be concerned improvement of the living environment of local communities (article 29).	protected land and the living environment of local communities. <ul style="list-style-type: none"> • Activity 3.1.1.2: Flood and drought development plans are aligned with national and international climate objectives and national development plans and programs. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
	Law No. 1/02 of March 26, 2012 on the Water Code in Burundi and its implementing texts. ⁵⁸	The water code stipulates protected zones: 150 m wide on the shores of Lake Tanganyika, 25 m on each side of the lake's tributary rivers and 5 m for rivers not tributary to the lake. In the implementation of the project, it will be necessary to avoid carrying out investments in these areas, except for irrigation works.	<ul style="list-style-type: none"> • Activities 2.1.2.1., 2.1.3.1., 2.1.3.2., 2.2.1.1, 2.2.3.2, 2.2.3.3., 2.2.3.5: Construction of adaptation technologies (e.g. mobile flood barriers, storage facilities, irrigation system) takes into consideration the protected zones. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
10. <i>Conservation of Biological Diversity</i>	Law No. 1/10 of June 30, 2000 on the Environmental Code of the Republic of Burundi (Titles III and IV). ⁵⁹	Works, structures and facilities to be carried out in the beds of watercourses will be designed and built in such a way as to maintain a minimum flow or volume of water guaranteeing the life, movement and reproduction of the species that inhabit the water at the time of carrying out these works, structures and developments (section 53).	<ul style="list-style-type: none"> • Activity 2.2.3.1: A water harvesting and storage infrastructure will be constructed that shall not obstruct a minimum flow or volume of water guaranteeing the life, movement and reproduction of the species that inhabit the water. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>

⁵⁷ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁸ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁹ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

	Law No. 1/28 of 24/12/2009 relating to the health policy of domestic, wild and aquaculture animals and bees. ⁶⁰	The law gives responsibility to three Ministries to protect animals. These are the Ministry of Agriculture and Livestock, the Ministry of Water, the Environment, Territorial Development and Urban Planning and the Ministry of Public Security.	<ul style="list-style-type: none"> • Activity 2.2.3.1: Water harvesting structures are in place to improve water security for animals such as livestock. • Activity 3.1.1.1: Flood and drought management plans take into consideration the protection of animals. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
11. <i>Climate Change</i>	The United Nations Framework Convention on Climate Change (UNFCCC). ⁶¹	Take precautionary measures to prevent or mitigate the causes of climate change and limit their harmful effects (Article 3)	<ul style="list-style-type: none"> • Activities 2.1.2.1., 2.1.3.1., 2.1.3.2., 2.2.1.1, 2.2.3.2, 2.2.3.3., 2.2.3.5: Construction of adaptation technologies (e.g. mobile flood barriers, storage facilities, irrigation system) takes into consideration the impact on climate change. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
12. <i>Pollution Prevention and Resource Efficiency</i>	Law No. 1/02 of March 26, 2012 on the Water Code in Burundi and its implementing texts. ⁶²	Appropriate measures must be taken at all levels to ensure efficient management of resources and infrastructures, and to reduce the costs of water services.	<ul style="list-style-type: none"> • Activity 3.1.1.1: Flood and drought management plans describe how to ensure efficient management of water and supporting infrastructures. • Activities 3.1.2.1, 3.1.2.4 and 3.1.2.5: Capacity building of various stakeholder groups and innovative adaptation practices enable efficient management of water and supporting infrastructures.

⁶⁰ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁶¹ https://www.obpe.bi/images/pdf/strategic_framework_environment_management.pdf

⁶² <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

			The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]
13. <i>Public Health</i>	Decree 100/177 of July 9, 2013 on health inspection measures for animals and food products of animal origin. ⁶³	This decree lays down the health inspection and control measures for animals and products of animal origin, including live animals, meat, milk and dairy products (see chapter II, section 2, 3 and 5).	<ul style="list-style-type: none"> • Activities 2.2.3.3: Harvested water will be made suitable for livestock to prevent health issues. • Activities 3.1.2.5: Farmer and pastoralist groups are trained on innovative climate smart agricultural/livestock practices keeping in mind health measures. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
	Decree-Law No. 1/033 of June 30, 1993 on plant protection in Burundi. ⁶⁴	This law establishes the principles and rules governing phytosanitary protection in Burundi. Phytosanitary treatments must be carried out in compliance with good agricultural practices in order to preserve human and animal health and protect the environment.	<ul style="list-style-type: none"> • Activities 3.1.2.5: Farmer and pastoralist groups are trained on innovative climate smart agricultural/livestock practices keeping in mind health measures. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
14. <i>Physical and Cultural Heritage</i>	Law No. 1/6 of May 25, 1983 on the protection of the National Cultural Heritage. ⁶⁵	An asset classified as cultural heritage cannot be altered, degraded or destroyed; it is prohibited to use it for inscriptions, graffiti or displays. A classified property cannot be moved, notified, repaired, transformed or restored without the prior authorization of the	<ul style="list-style-type: none"> • Activities 2.1.1.1 and 2.2.1.1: Development of flood and drought scenarios takes into consideration protection of cultural heritage sites. • Activities 2.1.2.1., 2.1.3.1., 2.1.3.2., 2.2.1.1, 2.2.3.2, 2.2.3.3., 2.2.3.5: Construction of adaptation technologies (e.g. mobile flood barriers, storage facilities, irrigation system) takes into consideration the protection of cultural heritage sites.

⁶³ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁶⁴ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁶⁵ http://www.african-archaeology.net/heritage_laws/burundi1983.html

		<p>Minister of Culture, taken on the assent of the Commission.</p>	<ul style="list-style-type: none"> • Activity 3.1.1.2: Flood and drought management plans aim impact on cultural heritage sites. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>
<p>15. <i>Lands and Soil Conservation</i></p>	<p>Law No. 1/10 of June 30, 2000 on the Environmental Code of the Republic of Burundi (Titles III and IV).⁶⁶</p>	<p>The preservation of soil against erosion is a national and individual ecological duty, and the measures to be taken to achieve this objective may be declared of public utility and be binding on any operator or occupant land (article 29).</p>	<ul style="list-style-type: none"> • Activity 2.1.1.2: Adaptation benefits are determined from mobile flood barriers including preservation of soil against erosion. The flood barrier structure is designed prevent erosion. <p>The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>

⁶⁶ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

Table D.: Overview other relevant technical standards and compliance by project

Source	National text enacting the standard	Standard	Project relevance and compliance
	<p>Law No. 1/03 of January 4, 2001 on the national system of standardization, metrology, quality assurance and testing.⁶⁷</p>	<p>This law empowers the BBN to take charge of the standardization, metrology and quality assurance of all marketed products. The activities of the BBN are specified in joint ordinance No. 340 of 05/11/2013 on quality control of marketed products. This ordinance applies to products and goods imported or manufactured in Burundi.</p>	<ul style="list-style-type: none"> <li data-bbox="1222 300 1927 423"> <p>Activity 3.1.2.5: Farmers and pastoralists are trained on innovative climate smart agricultural extension services. These practices take into consideration the requirements set forth by BBN.</p> <p data-bbox="1270 461 1927 553">The [INSERT AUTHORITY] will monitor compliance with this law and national standards through [EXPLAIN HOW]</p>

⁶⁷ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

Table E: Ongoing and planned initiatives related to flood and drought risk management in Burundi

Project/programme	Objective(s)	Scope	(Non) Duplication/alignment
<p>1. Programme: Climate proofing food production investments in Imbo and Moso basins in the Republic of Burundi.⁶⁸</p> <p><i>Approved 2020</i></p>	<ul style="list-style-type: none"> Transforming current agro-ecological land and water management practices in the upper, middle, and lower Imbo and Moso catchments towards more sustainable and productive land use practices. Build farmers' resilience to climate change in the upper, middle, and lower Imbo and Moso catchments and to increase agricultural productivity and food security through adoption of better agroecosystem management practices to conserve soil and water resources. 	<p>Region Imbo and Moso basins</p> <p>Deliverables</p> <ul style="list-style-type: none"> Design and implement landscape management plans with farmers for soil and water practices. Supporting capacity building and implementation of water harvesting structures. Supporting improved post-harvesting activities. Training of farmers in soil and water conservation practices. 	<p>(Non) Duplication</p> <ul style="list-style-type: none"> Imbo basin is in scope but the Moso is not. The flood and drought risk management plans include landscape management and soil and water practices; however, these take into account technologies as mobile flood barriers. The programme implements harvesting structures at a large scale rather than on household level. The programme implements a solar powered cold storage unit as part of post harvesting activities. <p>Alignment</p> <ul style="list-style-type: none"> Floods will be prevented and water will be stored in a water harvesting structures to enhance water security. Agroecosystem management practices will be implemented to increase agricultural productivity and food security through better to conservation of soil and water resources.
<p>2. Programme: Community Disaster Risk Management in Burundi (<i>Bugesera</i>,</p>	<ul style="list-style-type: none"> Early warning systems (on climate change induced risks including new or emerging vulnerabilities and 	<p>Region Bugesera, Mumirwa and Imbo Lowlands.</p> <p>Deliverables</p>	<p>(Non) Duplication</p> <ul style="list-style-type: none"> Both programs cover Bujumbura Rural Province which is in the Imbo Lowlands Region.

⁶⁸ <https://www.greenclimate.fund/sites/default/files/document/sap017-ifad-burundi.pdf>

<p><i>Mumirwa and Imbo Lowlands regions</i>)⁶⁹</p> <p><i>Approved 2014</i></p>	<p>hazards) established for communities.</p> <ul style="list-style-type: none"> Livelihoods and infrastructure risk assessment undertaken with gender-focused analysis. Policy actions undertaken on the basis of anticipated climate change projections. Flood Control in Bujumbura. 	<ul style="list-style-type: none"> Community Based Early Warning System on climate change related risks in Bujumbura Rural, Kirundo and Makamba Provinces. Hydrometeorological network and improving capacity to generate real-time information weather and data series for information dissemination to target communities. Effective and efficient communication and dissemination system to reach all end users. Gender and climate vulnerability assessment to guide the development of a local climate change response. Stabilization works undertaken in Ntakangwa and Gaseyni Rivers to reduce the risk of flooding landslides in Bujumbura City. 	<ul style="list-style-type: none"> The programme implements flood and drought early warning hard- and software. Gap analyses will be conducted to prevent duplication. The programme implements knowledge and information sharing system. Gap analyses will be conducted to prevent duplication. The programme conducts risk assessments and benefit analyses. However, the assessments are conducted using innovative software and considering innovative response measures such as mobile flood barriers. <p>Alignment</p> <ul style="list-style-type: none"> Implementation of information services including flood and drought early warning systems. Adaptation benefits mechanism is developed and applied to perform flood and drought risk analyses and interventions are designed to support vulnerable groups. The impact of climate change on flood and drought risks are analysed and corresponding adaptation actions are designed and incorporated in policies and plans. Flood control structures will be implemented in Bujumbura to enhance resilience to floods.
<p>3. Programme: Restructuring of the Value Chain Development</p>	<ul style="list-style-type: none"> Contribute to increasing incomes and improving the food security and nutrition of poor households in 	<p>Region Bubanza, Cibitoke, Gitega, Karusi, Kayanza, Muramvya and Ngozi Province.</p>	<p>(Non) Duplication</p> <ul style="list-style-type: none"> The programme also covers Cibitoke and Bubanza Province.

⁶⁹ <https://www.thegef.org/projects-operations/projects/4990>

<p>Programme (PRODEFI)⁷⁰</p> <p><i>Approved 2015</i></p>	<p>a sustainable manner in areas of intervention by strengthening priority agricultural sectors (rice and milk). In addition, enhance the resilience of production systems and the facilitation of a sustainable partnership with public, private and civil society institutions.</p>	<p>Deliverables</p> <ul style="list-style-type: none"> • Irrigation schemes and infrastructure. • Design of rural engineering structures to climate variability. • Intensification of agricultural production. • Support to priority sectors 	<ul style="list-style-type: none"> • The programme implements irrigation schemes/infrastructure, but with different technologies. The programme utilizes temporary barriers to harness flood water. • The programme designs and executes engineering activities. PRODEFI “merely” build capacities and set (technical) standards. • The programme improves agricultural production through smart practices and software; PRODEFI focused on seeds, fertilizers etc. <p>Alignment</p> <ul style="list-style-type: none"> • Implementation of water harvesting infrastructure and an irrigation system to strengthen water security in line with technical standards. • Reshaping of rural land to optimise the habitability and land productivity especially for the priority sectors. • Capacity building of different stakeholder groups to improve skillset to enhance resilience to floods and drought using innovative adaptation practices, tools and technologies.
<p>4. Programme: Burundi Landscape Restoration Project⁷¹</p> <p><i>Approved 2016</i></p>	<ul style="list-style-type: none"> • Restore degraded landscapes by community members in two priority regions, and in the event of an eligible crisis or emergency, to provide 	<p>Region</p> <p>(North-West region) Bubanza, Kayanza, Bujumbura Rural, (East region) Cankuzo, Ruyigi and Muyinga Province</p> <p>Deliverables</p>	<p>(Non) Duplication</p> <ul style="list-style-type: none"> • The programme also covers Bubanza and Bujumbura Rural Province. • The programme will conduct capacity building of local institutions, though not specifically on land restoration; it

⁷⁰ <https://www.ifad.org/documents/38711624/40089492/PRODEFI+II+Rapport+de+conception+dtaille.pdf/6b0c1812-9550-4763-9d46-a26dc6ce7b73?t=1611227252000>

⁷¹ <https://documents1.worldbank.org/curated/en/408471487004538339/pdf/ITM00184-P160613-02-13-2017-1487004534488.pdf>

	<p>immediate and effective response to said eligible crisis or emergency.</p>	<ul style="list-style-type: none"> • Strengthened role of traditional and local institutions in landscape restoration. • Enhanced access to improved climate information and early-warning systems. • Investments in restoration of degraded lands and support ecosystem-based adaptation. 	<p>will focus on land use management in light of flood and drought management.</p> <ul style="list-style-type: none"> • The programme will enhance/implement early warning systems and improve access. It is unclear to what extent this element is overlapping; gap analyses are conducted to prevent duplications. • This programme invests in restoration and adaptation, however using different practices, tools and technologies. The completed project focused more on nature-based solutions. <p>Alignment</p> <ul style="list-style-type: none"> • Enhance resilience to floods and drought along catchments using information services and other technologies such as flood barriers. • Smart agriculture practices are implemented to restore land productivity and prevent loss of productivity due to floods and drought. • Capacity building of institutions to improve skillset required to restore landscapes after a flood or drought event.
<p>5. Programme: Natural Landscapes Rehabilitation and Climate Change Adaptation in the Region of Mumirwa in Bujumbura and Mayor of Bujumbura through a Farmer</p>	<p>Address the root causes of landscape degradation due to climate change and unsustainable land uses by rehabilitating degraded land and adapting integrated farming and natural systems to climate change in the.</p>	<p>Region Region of Mumirwa in Bujumbura Mairie and in the Lake Tanganyika coastal area.</p> <p>Deliverables</p> <ul style="list-style-type: none"> • Training to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures. 	<p>(Non) Duplication</p> <ul style="list-style-type: none"> • The programme covers Bujumbura Marie and part of the Lake Tanganyika coastal area. • The programme identifies, prioritizes, implements, monitors and evaluates adaptation strategies, but centred around new adaptation measures. • The programme conducts risk assessments, albeit with state-of-the-art modelling software and considering new adaptation measures.

<p>Field School Approach⁷²</p> <p><i>Approved 2019</i></p>		<ul style="list-style-type: none"> • Risk and vulnerability assessments and relevant technical assessments carried out and updated. • Institutional arrangements to lead, coordinate and support the integration of climate change adaptation (CCA) into relevant policies, plans and associated processes. • Type and extent of assets strengthened and/or better managed to withstand the effects of climate change. • Number of people/ geographical area with access to improved climate information services. 	<ul style="list-style-type: none"> • The programme establishes MoUs/agreements between stakeholder and reviews and amends policies, plans and processes taking into account new adaptation measures (e.g. mobile barriers). • The programme enhances resilience of assets to climate change but with new adaptation measures. • The programme enhances communities' access to flood and drought information services but using different channels e.g. APIs. <p>Alignment</p> <ul style="list-style-type: none"> • Capacity building of different stakeholder groups to improve skillset to enhance resilience to floods and drought using new adaptation measures. • Climate-smart practices and flood resilient measures, such as flood barriers, to protect ecosystems in a sustainable manner. • Deployment of water-filled barriers to prevent flooding and enable land reclamation. • Promotion of agricultural and livestock practices to adapt to climate change impacts.
<p>6. Programme: Consultancy to support delivering climate resilient and sustainable water services to rural</p>	<p>Provide technical assistance: (a) to undertake a climate risk assessment in five provinces in Burundi with a focus on water resources, and water service delivery</p>	<p>Region</p> <ul style="list-style-type: none"> • Five (undisclosed) provinces. <p>Deliverables</p> <ul style="list-style-type: none"> • A rapid risk assessment – desk-based using available 	<p>(Non) Duplication</p> <ul style="list-style-type: none"> • Although undisclosed, the four provinces of the programme are expected to be in scope of the planned programme.

⁷² <https://www.thegef.org/projects-operations/projects/8010>

<p>communities in Burundi.⁷³</p> <p><i>Planned for 2023</i></p>	<p>assets; and, (b) to provide technical inputs into the design of measures for climate-resilient catchment management and into the mitigation of climate risk to water service delivery assets.</p>	<p>data - to identify climate change hotspots in the five select provinces in Burundi.</p> <ul style="list-style-type: none"> In-depth assessment of risks stemming from climate change for the identified hotspot catchments. Identify suitable adaptation measures for catchments and provide technical assistance to design measures that combine grey, green and social investments. 	<ul style="list-style-type: none"> The programme conducts a risk assessment limited to flood and drought risk using newly developed intelligence software. The programme does not conduct in-depth risk assessments. The programme identifies and implements adaptation measures, however not focused on nature-based solutions. The programme implements new adaptation measures such as mobile flood barriers. <p>Alignment</p> <ul style="list-style-type: none"> The programme aims to enhance resilience to climate change in the water sector with a distinct focus on floods and drought. The programme conducts flood and drought risk assessment early-stage. The program designs and implements adaptation measures to enhance resilience.
<p>7. Programme: Community Disaster Risk Management in Burundi.⁷⁴</p> <p><i>Approved 2014</i></p>	<p>Improve local communities' capacities on climate disaster risks preparedness and responses management to ensure long term and sustainable emergency and reconstruction phase in Bugesera, Mumirwa and Imbo Lowlands' regions.</p>	<p>Region</p> <ul style="list-style-type: none"> Kirundo, Bujumbura Rural, Bururi and Makamba. <p>Deliverables</p> <ul style="list-style-type: none"> An operational Community Based Early Warning system established capable to engage and reach out target communities for climate change disasters risks prevention and guiding the implementation of adaptation activities. 	<p>(Non) Duplication</p> <ul style="list-style-type: none"> The programme covers Bujumbura Rural. The programme will implement a flood and drought early warning system for Bujumbura Rural as well as a platform on national level. There is a risk of duplication that shall be further explored. The programme will upgrade the hydrometeorological network and improve capacity to generate real-time information weather and data for information dissemination to target communities. There is a risk of duplication that shall be further explored.

⁷³ https://gca.org/wp-content/uploads/2022/08/GCA-PR-22-184-REOI-Climate-Resilient-and-Sustainable-Water-Services-in-Burundi-_Final95.pdf

⁷⁴ <https://www.thegef.org/projects-operations/projects/4990>

		<ul style="list-style-type: none"> Communal services, relevant ministry support services and Provincial disaster risks platforms trained to use climate risks management tools for long term planning under climate change variability and projections. Investment on relevant early warning systems and adaptation technologies to protect infrastructures and local livelihoods from climate impacts. 	<ul style="list-style-type: none"> The programme will setup an effective and efficient communication and dissemination system to reach all end users. There is a risk of duplication that shall be further explored. The programme will conduct risk and vulnerability assessments and response strategies, but taking into account the new adaptation measures. The programme will invest in flood and drought adaptation tools and technologies, albeit different intervention compared to the completed programme. <p>Alignment</p> <ul style="list-style-type: none"> The programme will improve local communities' capacities on flood and drought disaster risks preparedness and responses management using innovative adaptation practices, tools and technologies.
<p>8. Programme: Great Lakes Regional Integrated Agriculture Development Project.⁷⁵ <i>Approved 2017</i></p>	<ul style="list-style-type: none"> To increase agricultural productivity and commercialization in targeted areas in the territory of the recipient and improve agricultural regional integration. To provide immediate and effective response in the event of an eligible crisis or emergency. 	<p>Region</p> <ul style="list-style-type: none"> Ruzizi Plain and the Imbo region, and the geographic corridor along Lake Tanganyika <p>Deliverables</p> <ul style="list-style-type: none"> Facilitate farmers' access to improved production packages (e.g. seed). Promote the adoption of climate smart agriculture. Rehabilitate irrigation infrastructure and 	<p>(Non) Duplication</p> <ul style="list-style-type: none"> The programme covers (parts of) the Ruzizi Plain and the Imbo region. The programme implements smart agriculture practices supported by innovative software, though without improving access to production packages. The programme will implement an irrigation infrastructure, though in a unique setup where excess flood water is harnessed using mobile flood barriers. The programme conducts capacity building of people and institutions, though focused on the new adaptation practices, tools and technologies.

⁷⁵ <https://projects.worldbank.org/en/projects-operations/document-detail/P161781?type=projects>

		<ul style="list-style-type: none"> • Strengthen capacity of water user associations to manage irrigation systems and improve watershed management. • Strengthening of selected Business Development Services (BDS) (to support value chains). • Exchanges of information, knowledge, and technologies through channels such as a web-based exchange platform. 	<ul style="list-style-type: none"> • The programme supports linkages with potential buyers of agriculture and livestock products but also by emphasizing used of new adaptation measures. • The programme implements knowledge sharing and learning using different channels, though focussed on new adaptation measures. <p>Alignment</p> <ul style="list-style-type: none"> • The programme aims to enhance agricultural productivity and commercialization in the same region. The programme does this with a unique set of adaptation measures. • Both programmes aim to enhance emergency response in case of crisis situations. The proposed programme focusses on flood and drought crisis situations. The programme furthermore promotes the usage a unique adaptation measures including mobile flood barriers.
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Table F.: Mapping* of possible duplications with other programmes

Programme outcome	Cibitoke	Bubanza	Bujumbura Rural	Bujumbura Mairie
Outcome 1.1: Increased use of effective information technology by stakeholders.	P3, P6	P3, P4, P6	P2, P4, P6, P7	P6
Outcome 2.1: Increased uptake and usage of concrete and innovative flood adaptation actions.	P1, P3, P5	P1, P3, P5	P1, P2, P5, P7	P1, P5
Outcome 2.2: Increased uptake and usage of concrete and innovative drought adaptation actions.	P1, P3, P5, P8	P1, P3, P5, P8	P1, P2, P5, P7, P8	P1, P5, P8
Outcome 3.1: Flood and drought resilience of key stakeholders at regional, national and local levels strengthened.	P1, P3, P5, P6, P8	P1, P3, P4, P5, P6, P8	P1, P2, P4, P5, P6, P7, P8	P1, P5, P6, P8
Outcome 3.2: Partnerships for flood and drought management at regional, national and local levels strengthened.	P3, P5, P8	P3, P4, P5, P8	P4, P5, P7, P8	P5, P8
Outcome 4.1: Strengthened awareness and ownership of flood and drought adaptation and climate risk reduction processes at local level.	P3, P5, P6, P8	P3, P5, P6, P8	P2, P5, P6, P7, P8	P5, P6, P8

* "P" in the table refers to the programme numbers in Table 6

Table G.: Overview knowledge management strategy

Expected Outputs	Type of knowledge	Target audience/communication means	Expected results/knowledge products
<p>Output 1.1.1: Efficient and effective flood and drought information technology and services implemented.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought information technology and services. • Analysis of and experience with new flood and drought information technology and services. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. <p>Communication means</p> <ul style="list-style-type: none"> • Workshops • Travel • Interviews/surveys • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to enhance flood and drought information technology and services. • Local knowledge is enhanced on how to benefit from flood and drought information technology and services. <p>Knowledge products</p> <ul style="list-style-type: none"> • Design plans flood and drought information technology and services • Training plans/documents • Lessons learned documents
<p>Output 1.1.2: Collected and stored data to support flood and drought information services.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought data and data management. 	<p>Target audience</p> <ul style="list-style-type: none"> • Hydro/meteorological departments at national, regional and local level. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to enrich (high-quality) data and implement data management to support flood and drought information services. <p>Knowledge products</p> <ul style="list-style-type: none"> • Baseline study • Data management document
<p>Output 1.1.3: Institutional linkages for information established.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought information sharing frameworks. • Analysis of and experience with new flood and drought 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to establish and improve flood and drought information sharing frameworks.

	<p>information sharing frameworks.</p>	<ul style="list-style-type: none"> • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Workshops • Meetings • Interviews/surveys • Knowledge sharing platform 	<ul style="list-style-type: none"> • Knowledge on roles and responsibilities in the flood and drought information sharing framework is enhanced. <p>Knowledge products</p> <ul style="list-style-type: none"> • Flood and drought information sharing platform • Training plans/documents • Lessons learned documents
<p>Output 1.1.4: Feedback mechanism for information services developed.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought feedback information platforms. • Analysis of and experience with new flood and drought feedback information platforms. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Surveys 	<p>Results</p> <ul style="list-style-type: none"> • Enhanced feedback mechanism to disseminate information on flood and drought risks and adaptation. <p>Knowledge products</p> <ul style="list-style-type: none"> • Tools to access, utilize and report on flood and drought information
<p>Output 1.1.5: Emergency plan for flood and drought management is put in place.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought emergency response plans. • Analysis of and experience with new flood and drought emergency response plans. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. <p>Communication means</p> <ul style="list-style-type: none"> • Workshops • Interviews/surveys 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to establish and improve flood and drought emergency response plans. • Knowledge on processes and roles and responsibilities in flood and drought emergency response is enhanced. <p>Knowledge products</p> <ul style="list-style-type: none"> • Emergency response plans

		<ul style="list-style-type: none"> • Knowledge sharing platform 	<ul style="list-style-type: none"> • Flood and drought information sharing platform • Training plans/documents • Lessons learned documents
<p>Output 2.1.1: Flood risks analysed, and flood adaptation actions designed.</p>	<ul style="list-style-type: none"> • Analysis of flood risks and possible adaptation interventions. • Analysis of and experience with current flood risk adaptation interventions. • Analysis of and experience with new flood risk adaptation practices, tools and technologies. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops • Travel • Interviews/surveys • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding and increased awareness of flood risks. • Shared understanding of how to implement and improve upon innovative flood adaptation practices, tools and technologies. • Increased knowledge of processes and roles and responsibilities concerning new flood adaptation interventions. <p>Knowledge products</p> <ul style="list-style-type: none"> • Flood risk assessment • Flood adaptation benefit analysis • Flood information sharing platform • Training plans/documents • Lessons learned documents
<p>Output 2.1.2: Enabling environment for flood adaptive activities created.</p>	<ul style="list-style-type: none"> • Analysis of suitability of landscape/area to deploy a mobile flood barrier. • Analysis of impact flood risks on agriculture and pastoralist value chain. • Analysis of and experience with flood related insurance products. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. • Insurance companies 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding of current suitability of landscape for mobile flood barriers and how to increase suitability. • Shared understanding of the impact of flood risks on the agriculture and pastoralist value chain.

		<p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Travel • Workshops • Interviews/surveys • Knowledge sharing platform 	<ul style="list-style-type: none"> • Increased knowledge of flood insurance products and applicability of interventions such as mobile barriers. <p>Knowledge products</p> <ul style="list-style-type: none"> • Flood barrier situation analysis • Landscape/area suitability matrix • Agriculture and pastoralist value chain assessment • Flood risk insurance analysis
<p>Output 2.1.3: Innovative mobile flood prevention structures constructed.</p>	<ul style="list-style-type: none"> • Analysis of and experience with facilities (storage, infrastructure, transportation) to deploy mobile flood barrier. • Analysis of and experience with how mobile usage of a mobile flood barrier to prevent erosion. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at local level. • Disaster management authorities at local level. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Travel • Workshops • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding of optimal usage of facilities to support the deployment of a mobile flood barrier. • Shared understanding of how to use a mobile flood barrier to prevent erosion. <p>Knowledge products</p> <ul style="list-style-type: none"> • Flood situation analysis report • Flood adaptation guidelines • Training material flood adaptation • Lessons learned document
<p>Output 2.1.4: Adaptive flood prevention practices promoted.</p>	<ul style="list-style-type: none"> • Analysis of and experience with individual/communal practices to adapt to floods. • Analysis of and experience with agricultural and pastoralist practices to adapt to floods. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at local level. • Disaster management authorities at local level. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops 	<p>Results</p> <ul style="list-style-type: none"> • Increase knowledge of optimal individual/communal practices to adapt to floods. • Increased knowledge of optimal agricultural and pastoralist practices to adapt to floods. <p>Knowledge products</p> <ul style="list-style-type: none"> • Flood response guidelines

		<ul style="list-style-type: none"> • Knowledge sharing platform 	<ul style="list-style-type: none"> • Flood response runbook • Training material
<p>Output 2.2.1: Drought risks analysed, and drought adaptation actions designed.</p>	<ul style="list-style-type: none"> • Analysis of drought risks and possible adaptation interventions. • Analysis of and experience with current drought risk adaptation interventions. • Analysis of and experience with new drought risk adaptation practices, tools and technologies. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops • Travel • Interviews/surveys • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding and increased awareness of drought risks. • Shared understanding of how to implement and improve upon innovative drought adaptation practices, tools and technologies. • Increased knowledge of processes and roles and responsibilities concerning new drought adaptation interventions. <p>Knowledge products</p> <ul style="list-style-type: none"> • Drought risk assessment • Drought adaptation benefit analysis • Drought information sharing platform • Training plans/documents • Lessons learned documents
<p>Output 2.2.2: Enabling environment for drought adaptive activities created.</p>	<ul style="list-style-type: none"> • Analysis of impact drought risks on agriculture and pastoralist value chain. • Analysis of and experience with drought related insurance products. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. • Insurance companies <p>Communication means</p>	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding of the impact of drought risks on the agriculture and pastoralist value chain. • Increased knowledge of drought insurance products and applicability of interventions such as mobile barriers. <p>Knowledge products</p> <ul style="list-style-type: none"> • Agriculture and pastoralist value chain assessment • Drought risk insurance analysis

		<ul style="list-style-type: none"> • Meetings • Travel • Workshops • Interviews/surveys • Knowledge sharing platform 	
<p>Output 2.2.3: Innovative water harnessing and irrigation structures established.</p>	<ul style="list-style-type: none"> • Analysis of suitability of landscape/region to implement drought adaptation interventions. • Analysis of and experience with drought adaptation interventions. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at local level. • Disaster management authorities at local level. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Travel • Workshops • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding of optimal landscape/region to enable drought adaptation interventions. • Shared understanding of how to use drought adaptation interventions. <p>Knowledge products</p> <ul style="list-style-type: none"> • Drought situation analysis report • Drought adaptation guidelines • Training material drought adaptation • Lessons learned document
<p>Output 2.2.4: Adaptive drought prevention practices promoted.</p>	<ul style="list-style-type: none"> • Analysis of and experience with individual/communal practices to adapt to drought. • Analysis of and experience with agricultural and pastoralist practices to adapt to drought. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at local level. • Disaster management authorities at local level. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Increase knowledge of optimal individual/communal practices to adapt to drought. • Increased knowledge of optimal agricultural and pastoralist practices to adapt to drought. <p>Knowledge products</p> <ul style="list-style-type: none"> • Drought response guidelines • Drought response runbook • Training material

<p>Output 3.1.1: Flood and drought management plans (FDMPs) integrating climate change aspects and adaptation actions are developed.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought adaptation plans. • Analysis of and experience with new flood and drought adaptation plans. • Analysis of alignment flood and drought adaptation plans with (inter)national plans and policies. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops • Interviews/surveys • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to establish and improve flood and drought adaptation plans. • Knowledge on processes and roles and responsibilities in flood and drought adaptation is enhanced. • Increased alignment of flood and drought adaptation with (inter)national plans and policies. <p>Knowledge products</p> <ul style="list-style-type: none"> • Flood and drought adaptation plans • Flood and drought information sharing platform • Training plans/documents • Lessons learned documents • Plan and policy alignment document
<p>Output 3.1.2: Adaptive capacity of institutions, farmers, and pastoralists in flood and drought management is improved.</p>	<ul style="list-style-type: none"> • Analysis of capacity needs to adapt to floods and drought using innovative practices, tools and technologies. • Analysis of and experience with innovative flood and drought adaptation practices, tools and technologies. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops • Learning tours 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding of how to increase capacities of people and institutions to adapt to floods and drought using innovative practices, tools and technologies. • Increased knowledge of how to use innovative practices, tools and technologies to adapt to flood and drought. <p>Knowledge products</p> <ul style="list-style-type: none"> • Capacity assessment

		<ul style="list-style-type: none"> • Travel • Interviews/surveys • Knowledge sharing platform 	<ul style="list-style-type: none"> • Brochures/guidelines of the different practices, tools and technologies • Training plans/documents • Lessons learned documents • Plan and policy alignment document
<p>Output 3.2.1: New/existing regional and national arrangements/networks for flood and drought management supported.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current arrangements/networks for flood and drought management. • Analysis of and experience with current arrangements/networks for flood and drought management. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Forums • Workshops • Meetings • Interviews/surveys • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to establish and improve arrangements/networks for flood and drought management . • Increased knowledge of roles and responsibilities in the flood and drought management. <p>Knowledge products</p> <ul style="list-style-type: none"> • Multi-stakeholder arrangements/MoUs • Flood and drought information sharing platform • Flood and drought management plans • Lessons learned documents
<p>Output 4.1.1: Good practices and lessons on flood and drought management documented and disseminated.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current sharing and dissemination of lessons on flood and drought management. • Analysis of and experience with current sharing and dissemination of lessons on flood and drought management. 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p>	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to establish and improve sharing lessons on flood and drought management. <p>Knowledge products</p> <ul style="list-style-type: none"> • Knowledge sharing guidelines • Flood and drought information sharing platform • Training plans/documents • Lessons learned documents

		<ul style="list-style-type: none"> • Meetings • Workshops • Interviews/surveys • Knowledge sharing platform 	
<p>Output 4.1.2: Flood and drought information management strengthened.</p>	<ul style="list-style-type: none"> • Analysis of and experience with current flood and drought information management activities. • Analysis of and experience with new flood and drought information management activities 	<p>Target audience</p> <ul style="list-style-type: none"> • Local communities (incl. farmers and pastoralists) • Hydro/meteorological departments at national, regional and local level. • Disaster management authorities at national, regional and local level. • Other governmental bodies such as the Ministry of Environment, Agriculture and Livestock. <p>Communication means</p> <ul style="list-style-type: none"> • Meetings • Workshops • Interviews/surveys • Knowledge sharing platform 	<p>Results</p> <ul style="list-style-type: none"> • Shared understanding on how to establish and improve flood and drought information management. <p>Knowledge products</p> <ul style="list-style-type: none"> • Knowledge sharing guidelines • Monitoring and evaluation framework • Flood and drought information sharing platform • Training plans/documents • Lessons learned documents

Table H.: Outcome scoring matrix mitigation measures

	Relevance			Effectiveness			Sustainability				Efficiency		Impact		Total	Score out of 10
	Sensitive to situation	Partner/ institution	Beneficiaries	Goals and needs (floods)	Goals and needs (other)	Added benefits	Environmental	Financial (maintenance)	Technological	Institutional/ social	Cost-effectiveness	Time- effectiveness	Extent	Long-term		
1. SLAMDAM	3	2	2	2	2	3	2	3	3	3	2	3	1	2	33	7.857
2. Development of drainage systems	3	3	3	3	1	2	3	1	2	3	2	1	2	2	31	7.381
3. Excavation/ widening of river bed	3	1	1	3	1	0	1	0	1	1	1	1	2	2	18	4.286
4. Retarding Basin/ Pond	2	2	2	2	2	1	1	2	2	2	1	2	2	2	25	5.952
5. Infiltration area	2	2	2	1	3	3	3	2	2	2	1	1	1	3	28	6.667
6. Sandbags	3	1	2	1	0	1	2	2	1	2	2	3	0	1	21	5.000
7. Forestation	1	3	3	1	3	3	3	3	2	3	2	0	1	3	31	7.381
8. Flood early warning system (FEWS)	2	3	2	1	0	2	3	1	2	2	3	3	3	2	29	6.905
9. Flood Hazard map	3	2	1	1	1	1	3	2	2	2	3	2	3	2	28	6.667

Score	
0 =	Bad
1 =	Low
2 =	High
3 =	Very high

**Addressing Flooding and Drought with a unique combination of flood
and drought resilient solutions in the Imbo Basin in Burundi.**

Pre-Feasibility Study

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Executive Summary

This document presents the outcomes of a pre-feasibility study on the use of a unique combination of interventions, centered around a water-filled mobile flood barrier, to enhance resilience to flood and drought risk in the Imbo Basin in Burundi. This document furthermore presents the planning for the next phases starting with the pre-feasibility study.

A warmer climate, with its increased climate variability, will increase the risk of both floods and droughts (IPCC, 2007). Flood and drought-related acute food insecurity and malnutrition have increased in Africa and Central and South America (IPCC, 2022). As there are a number of climatic and non-climatic drivers influencing flood and drought impacts, the realisation of risks depends on several factors. Human encroachment into flood plains and lack of flood response plans increase the damage potential.

Burundi has a history of extreme events that are considered climate related. The Imbo Plan in the northern part of the country experiences (i) frequent excessive rains, causing floods and occasionally significant increases in the water level of Lake Tanganyika and (ii) frequent rainfall shortages. Under current climate change trends there will be a significant impact on some of the principal food and commercial crops in Burundi. Maize (a secondary staple crop), beans and sweet potato yields are expected to decrease gradually, with maize yield decreases of 5-25% predicted for the next decades¹. Rising temperatures and erratic or lower rainfall will have a negative impact on Burundi's primary exports of coffee and tea, which account for 90% of foreign exchange earnings². Extreme floods and droughts are estimated to result in a reduction of long-term growth by 2.4% of GDP per year³. Burundi is desperately looking for solutions to mitigate both flood and drought risk.

A small-scale pilot project was implemented in Burundi in 2022 that aimed to demonstrate the effectiveness of a water-filled mobile flood barrier in enhancing resilience to flood and drought risk. The project was completed successfully and to the satisfaction of stakeholders from local communities up until the highest level in the political landscape. After demonstrating that the mobile flood barrier can effectively reduce flood and drought risk, it was decided to scale-up this solution to increase the number of benefits that can be realised with this technology. The idea is to implement a combination of flood and drought adaptation measures that centre around the water-filled mobile flood barrier at the Imbo Basin in Burundi, the region that is hit hardest by flood and drought events. This portfolio of adaptation measures might become a blueprint of a solution that can be scaled up across other regions in Burundi and even in other countries to mitigate flood and drought risk.

The envisioned combination of adaptation measures comprises of: (i) a water-filled mobile flood barrier, (ii) a water harvesting infrastructure, (iii) a pumping and irrigation system, (iv) a solar-powered cold storage, (v) information technology, and (vi) adaptation practices. An Adaptation Benefits Mechanism (ABM) methodology shall be used to assess the anticipated Adaptation Benefits (ABs) from implementing the portfolio of adaptation measures. The ABs shall give stakeholders insight in what they can expect from implementing said interventions. The assumption is that measuring and communicating ABs shall ease the mobilization of

¹ Baramburiye et al. (2013)

² Ross, P (2015) Climate Change Effects On Coffee Production: How Hotter Weather Is Killing The Global Arabica Bean Market <http://www.ibtimes.com/climate-change-effects-coffee-production-how-hotter-weather-killing-global-arabica-1905151>

³ DFID (2011): The economic impacts of climate change in Burundi. <http://weadapt.org/knowledge-base/economics-of-adaptation/economics-of-adaptation-burundi>

funds from donors considering it becomes transparent what they can expect in return of their investment.

This study builds upon the knowledge and expertise from the pilot project by engaging many of the same stakeholders such as: (i) ministries, (ii) communities, (iii) farmers, (iv) hydrologists, (v) a financial institution, (vi) flood and drought consultants and (vii) a local NGO. All members involved in this study agree with the viability to proceed with the feasibility study from a technical and political standpoint.

The initial design of the adaptation measures has been conducted using (i) the input from stakeholders and (ii) analyses using hydrodynamic modelling software. Both sources were also used to determine potential locations where the interventions could be implemented.

In conclusion, the study supports the claim that negative impacts caused by flooding and drought in the Imbo Basin in Burundi can effectively be addressed with the combination of adaptation measures that centre around the water-filled mobile flood barrier. With the planning in place and the support by relevant stakeholders, all that is left is to obtain funding required to conduct the feasibility study.

1. Ambition of the study

Interventions aimed at enhancing resilience to flood and drought events keep on developing to increase effectiveness to adapt to the adverse impacts of climate change. Combining and streamlining innovative adaptation tools and technologies modernize the way flood and drought risks are managed. A unique combination of resilient measures that proves to be effective can become a blueprint to scale-up in other regions and countries to help communities reduce vulnerabilities to climate change. The envisioned combination of adaptation interventions include: (i) water-filled mobile flood barriers, (ii) water harvesting infrastructure, (iii) solar pumping and irrigation system, (iv) solar powered cold storage, (v) innovative information technology such as Early Warning Systems (EWSs) and (vi) adaptation practices.

The ambition of the study is to conduct a preliminary assessment of the feasibility of the combination of innovative adaptation tools and technologies and its ability to mitigate flood and drought risks in the Imbo Basin in Burundi. The study focuses on pluvial and fluvial flooding in rural and urban areas and how the same areas are impacted by drought. The geographical focus is the Imbo Basin in Burundi with a specific focus on four provinces: (i) Cibitoke, (ii) Bubanza, (iii) Bujumbura Mairie and (iv) Bujumbura Rural Province (see Figure 1).

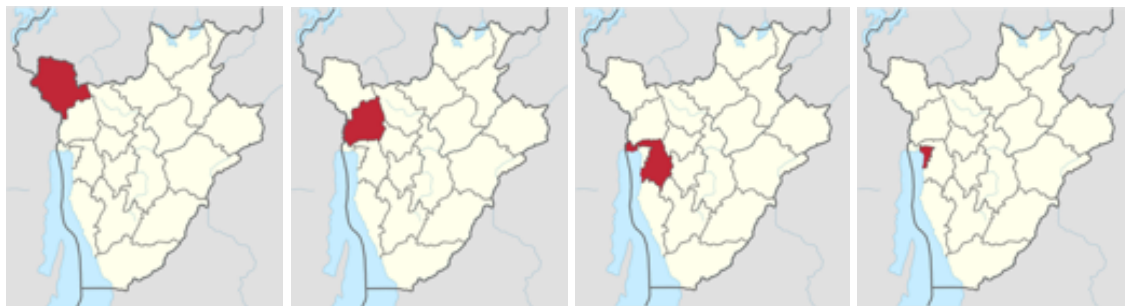


Figure 1: Cibitoke, Bubanza, Bujumbura Rural and Bujumbura Mairie Province

The reason for selecting these provinces for the study is because the communities face the following main flood and drought related challenges:

- In terms of the environmental conditions, communities in these provinces experience high rainfall variability with increasing frequency and intensity of flood and drought occurrences and high environmental degradation (focusing on vegetation and soil degradation as well as degradation and deterioration of water resources).
- Communities inhabiting such sites are also food insecure characterized by recurrent famine and a shortage of food. There is high dependence on the rain-fed agriculture especially high dependence of farmers and pastoralists on crop and livestock farming.
- Socially, there are many vulnerable members among the smallholder farmers and pastoralists especially women, children, youth, disabled and elderly by gender. Low-income levels of the population/high poverty levels in such sites therein are known and reported.
- Economically, smallholder farmers and pastoralists have limited options in terms of the potential alternative sources of livelihoods and income.

The envisioned combination of adaptation measures is expected to maximize the potential of natural systems to deliver critical services through flood risk reduction and water security.

The integration of water harvesting infrastructure and a pumping and irrigation system is essential for mitigating floods as well as droughts. Solutions that center around innovative water-filled flood barriers could be extremely effective in addressing sustainable water management.

This study focuses especially on the water-filled mobile flood barrier and supporting software solutions even though these technologies are (only) part of a broader scope of interventions. The study follows this approach considering that these innovative measures are the drivers of the other streamlined interventions.

The assumption of the study is that pluvial and fluvial flooding and drought are natural phenomena that will happen, and even exacerbate, in the future regardless of the measures in place. The study explores how to limit the adverse impacts of flooding and drought and safeguard communities and valuable areas through the implementation of a unique combination of measures on a local and or regional scale. Thus, the aim of the study is to identify potentially suitable interventions that could help to mitigate the unwanted impacts of floods and droughts on communities, industries, and infrastructure networks. The proposed interventions aim at maximizing flood and drought safety as the primary need especially for vulnerable and marginalized groups, whilst optimizing for other important regional needs such as food and water security and socio-economic and environmental wellbeing. For example, water-filled mobile barriers are expected to tackle the existing water crises that affects farmers and their production; farmers are seen as one of key beneficiaries.

This study builds upon a pilot project that was implemented in the Bubanza Province in 2022, which aimed to demonstrate the effectiveness of a water-filled mobile flood barrier. That project was financed by the United Nations Environment Programme (UNEP) / Climate Technology Centre & Network (CTCN). The project demonstrated how the innovative water-filled flood barrier could significantly enhance resilience of the Mpanda Commune to flooding and drought. Hydrodynamic modeling software was used to analyse flood risks on the region. The flood barrier was deployed based on the outcome of the flood risk analyses.

Drought risks were analyzed to understand how the water-filled flood barrier could help the community reduce its vulnerability to drought risks. The water stored in the flood barrier was used to irrigate crop land during dry season, enabling crops production and therewith improving food security and the economy.

The successful outcome of the project led to the decision to scale up this technology to increase the adaptation benefits, albeit as part of a broader scope of interventions. Many consultations with experts and local stakeholder have resulted in an envisioned portfolio of streamlined measures driven by the proven water-filled mobile flood barrier and software. The results and lessons learned of the pilot project are included in the study.

This study is the first step towards the development of a feasibility study that aims to validate the present assumptions and recommendations and initiate the programme design and implementation.

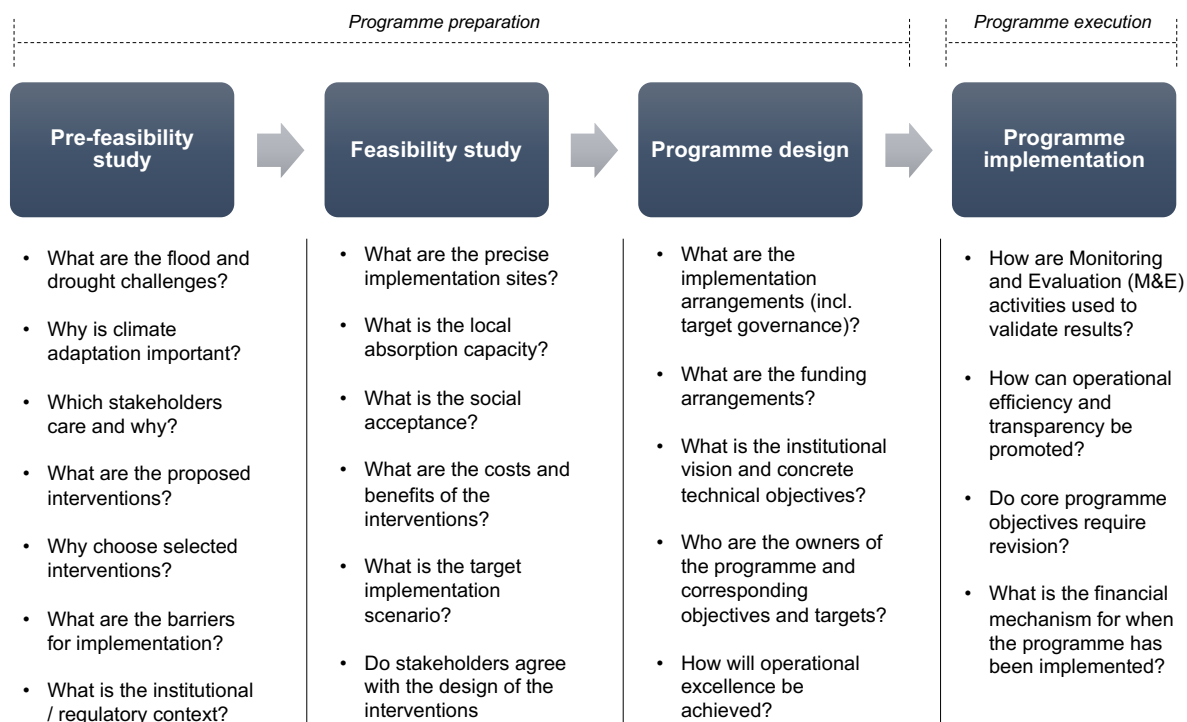


Figure 2: Guiding questions for each stage of the programme cycle

The study focused on the following objectives:

- i. Establishment of a working group with local and international experts to obtain relevant high-level knowledge and experience.
- ii. Articulation of flood and drought related challenges in the region of the Imbo Basin.
- iii. Mapping the stakeholder landscape and institutional profile of actors.
- iv. Mapping existing local policies, plans and initiatives in flood prevention.
- v. Identification of potential areas for implementation of the interventions.
- vi. Proposal of a set of potential projects likely to be suitable for the region.
- vii. Initial assessment of benefits of the envisioned unique combination of interventions.
- viii. Feasibility assessment of the envisioned unique combination of interventions.

1.1 The approach consists of a portfolio of flood and drought adaptation measures

Conventional projects/programmes tend not to follow a holistic approach to enhance resilience to flood and drought. Such projects limit their activities to certain measures such as a software solution or structural flood preventive measures. Structural flood resilient measures can be expensive and can have a significant impact on the people and the landscape. Such measures don't always have the ability to adapt to changing weather patterns and changing landscape e.g., due to urbanization. In addition, these measures often require high skilled labor to operate and maintain these to ensure effective performance. Measures such as sandbags are not always effective, not in the least part because it takes a long time to deploy these during a flood situation. NbSs can be effective, however these often take a long time to develop; this poses a challenge seeing as the need for effective adaptation measures is urgent.

Compared to structural solutions and NbS, a water-filled mobile flood barrier can be an effective resilient measure in "unexpected situations". Such situations tend to occur more

often due to climate change. A water-filled mobile flood barrier can be deployed easily at different locations and at any time. Conversely, the flood barrier can easily be dismantled when the risk has subsided.

Conventional adaptation measures can be expensive, incapable of adapting to changes and ineffective. Furthermore, projects often address only one part of the problem. Inefficiencies arise from not following a holistic approach and streamlining the various measures to enhance resilience to flood and drought.

The envisioned approach is to follow a holistic and innovative method to enhance resilience to flood and drought risks at the selected sites. The implemented pilot project in Burundi provided insight in what other interventions are needed. This pilot project, in combination an assignment by the University of Delft, were a trigger for designing a holistic approach to manage flood and drought risks using a unique combination of streamlined interventions. If successful, this approach could become a blueprint for future programmes across the country and other developing nations to enhance resilience to both flood and drought risks.

The next sections describe the different interventions that shall be streamlined and integrated into one holistic approach to combat flood and drought risks. An in-depth analysis was done on the water-filled mobile flood barrier considering that this measure is the most innovative and is the driver of the other interventions.

1.1.1 Combination of innovative flood and drought adaptation measures

The holistic approach to enhance resilience to flood and drought risks comprises of various types of streamlined interventions. Each intervention has a specific role to play in the overall approach. The water-filled mobile flood barrier lies at the heart of the approach seeing as it ties all other interventions together. This innovative technology is used for both flood and drought risks and is supported by information technology. Below table summarizes the different interventions included in the approach on which this study is based. The following sections describe the different categories of interventions in more detail with a distinct focus on the water-filled mobile flood barrier.

Table 1: Categories of interventions in the approach

Intervention	Description
1. <i>Water-filled mobile flood barrier (Paragraph 1.1.1.1.)</i>	The water-filled mobile flood barrier is a barrier made of EPDM (synthetic rubber) that can be deployed easily to prevent flooding at an area.
2. <i>Water harvesting infrastructure (Paragraph 1.1.1.2.)</i>	The water harvesting infrastructure harnesses water from flood / rain events using the mobile flood barrier to ensure water security in time of need.
3. <i>Pumping and irrigation system (Paragraph 1.1.1.3.)</i>	The pumping and irrigation system is used to move harnessed water to irrigate land or provide drinking water for livestock.
4. <i>Solar-powered cold storage (Paragraph 1.1.1.4.)</i>	Cold storage units powered by solar energy to store and preserve crops to improve food security and strengthen the economy.
5. <i>Information technology (Paragraph 1.1.1.5.)</i>	Hard- and software solutions to record and analyse flood and drought risks and signal warning in case of a threat.
6. <i>Adaptation practices (Paragraph 1.1.1.6.)</i>	New behaviors of stakeholders to strengthen resilience to flood and drought e.g., by growing crops that require less water.

1.1.1.1 Water-filled mobile flood barrier

A pilot project was implemented at the Mpandan Commune in the Bubanza Province in Burundi in 2022 that aimed to demonstrate a specific water-filled mobile flood barrier as an effective measure to enhance resilience to flood and drought. The barrier was deployed to protect agricultural land from being destroyed due to rising water levels of the nearby river. The flood barrier was left at the location where it was used for irrigation purposes during dry season by pumping out the water stored in the mobile flood barrier. The project was completed successfully and satisfactory to all stakeholders; Figure 3 gives an impression of the deployment of the flood barrier at the project site.



Figure 3: Deployment of the mobile flood barrier the pilot project in Burundi during in 2022

The barrier has a unique and innovative design and material combination. The product is made of Ethylene Propylene Diene Monomer (EPDM), which is a highly flexible synthetic rubber. EPDM yields high heat, ozone, and weather resistance. This is important as these properties benefit the long-life expectancy of the barrier. An important feature of the EPDM is that it does not pollute the water. The flood barrier can be a useful measure in unexpected situations due to its mobility and ease to deploy.

Other benefits of the water-filled flood barrier:

- The material of the flood barrier has a lifespan of at least 40 years, when properly used. This makes the barrier a highly sustainable solution.
- The water-filled flood barrier is UV-resistant, and you can store fluids vapor tight.
- The water-filled flood barrier is 100% recyclable.
- The water-filled flood barrier can easily be stored in stackable boxes.
- The water-filled flood barrier can be deployed with a few people and filled with a waterpump without the need for heavy equipment.
- The water-filled flood barrier is a modular system that can be customized if needed.

- Due to its concave shape, the force of the flood acts under an angle thus pushing the water-filled flood barrier towards the ground; this ensures the barrier does not move.

There is a set of boundary conditions that provides guidance on where the water-filled flood barrier could be deployed successfully. These boundary conditions shall be used during the feasibility study to determine on a precise level where this intervention can be implemented. The barrier can be implemented in urban and rural areas for different types of flooding, which opens the number of possible locations where this intervention can be implemented. Figure 4 reflects how the water-filled mobile flood barrier can be deployed to prevent fluvial flooding in a rural area.



Figure 4: Innovative mobile flood barrier will be implemented

1.1.1.2 Water harvesting infrastructure using water-filled barriers

There are multiple approaches to use the water-filled mobile flood barrier as an intervention to strengthen water security to combat drought: (i) the water stored in the flood barrier can be used as a source of water, (ii) a basin can be built with the barrier to collect and contain rainwater and (iii) the water-filled barrier can be used to redirect water during a flood event and store it in large quantities in a structure such as a manmade lake. During the pilot project, the water-filled flood barrier was used to enhance resilience to flooding and the water stored in the mobile barrier was used by smallholder farmers to irrigate their land during dry season as shown on the figure below. They continued using the barrier as a reservoir to store water from the river.



Figure 5: Water stored in the flood barrier was used for irrigation purposes

The new approach in this study aims to use the water-filled flood barrier to create a water harvesting infrastructure in addition to using it for flood prevention purposes. The water stored in the water-filled mobile flood barrier can be used for irrigation purposes similar to the pilot project. To realise more benefits, the aim is to store larger quantities of water to improve the level of water security and the extent to which it can be used for irrigation purposes or as drinking water for livestock. The envisioned setup is to deploy the water-filled mobile barrier upstream and create a corridor to redirect water during a flood event and harness it in a manmade lake. Water might be transferred into a different water harvesting infrastructure such as a water tower; that remains yet to be seen. This setup, illustrated with Figure 6, allows for storage of water in large quantities in addition to the water stored in the mobile flood barriers.



Figure 6: Water-filled flood barrier will serve as a water harvesting infrastructure

This setup aims to realise significant benefits for stakeholders such as local communities and local farmers. Furthermore, the water-filled flood barrier can be dismantled after which it can be stored or used elsewhere leaving no lasting impact on the landscape.

1.1.1.3 Solar pumping and irrigation system

The water harvesting infrastructure, referred to in paragraph 1.1.1.2., is implemented upstream where the altitude is higher than downstream. This setup allows for the water to be moved downstream (primarily) using gravity. The approach in this study includes a solar pumping and irrigation system to move harnessed water to irrigate land in times of drought or to use it as drinking water for livestock. This intervention, see Figure 7, strengthens crops and livestock production when there is normally no water available. This intervention therewith directly contributes to a strengthened economy and improved food security.

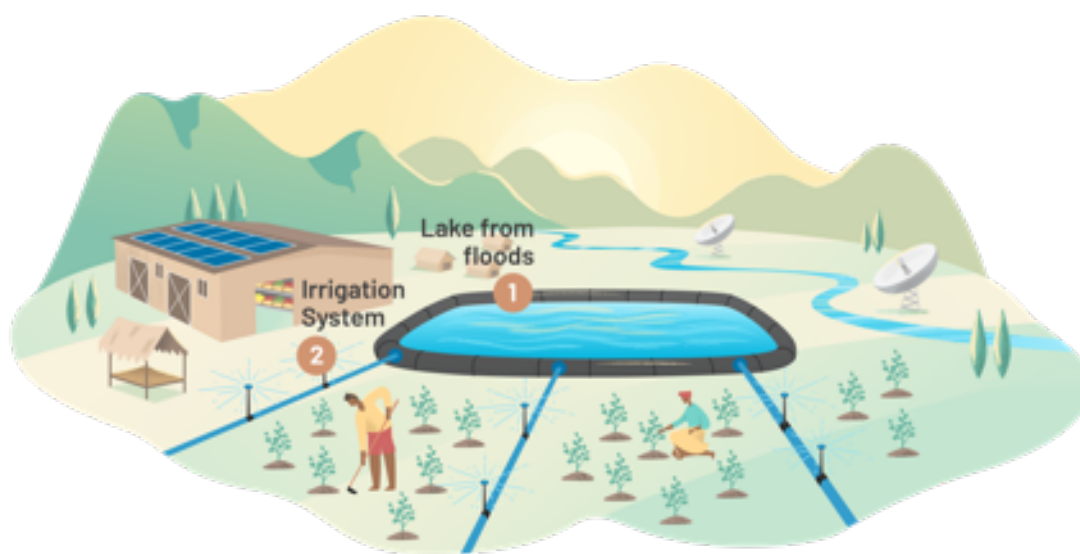


Figure 7: Solar pumping and irrigation system

Seeing as the solar energy is used for the pumping and irrigation system and gravity to move water, there is no negative impact on the climate. The feasibility study shall assess per location to what extent water shall be used for irrigation purposes and as drinking water.

1.1.1.4 Solar-powered cold storage

When crops and livestock production increase, it is imperative to ensure food products are preserved to strengthen food security throughout the year and to improve the economy. Cold storage units ensure that food products don't get spoiled for a longer period of time. This enhances food security on a national level seeing as food can be preserved and transported to other locations. The cold storage unit, see Figure 8, is powered with solar energy and shall therefore not have a negative impact on the climate.



Figure 8: Solar-powered cold storage unit to store crops

The size, location and specifications of the solar powered cold storage unit depend on the types of food products that shall be stored and the distance and mode of transportation from the sites where production takes place. The feasibility study shall give clarity on the size, location, and specifications of the solar powered cold storage unit(s).

1.1.1.5 Supporting innovative information technology infrastructure and services

Information technology plays a crucial role in designing the interventions and enhancing resilience to flood and drought risks. The approach in this study includes hard- and software solutions to gather and analyze data to support effective flood and drought risk management. Hardware solutions such as weather stations collect weather data that enable a common understanding of flood and drought risks. The collected data are stored and analyzed using innovative information solutions. The primary information services include (i) 3Di hydrodynamic modeling software, (ii) Flood Intelligence Service (FIS), (iii) the Optimal Dam Locator and (iv) a Flood and Drought Early Warning System. The following section provides a more detailed description of the different information services.

3Di hydrodynamic modeling software

The approach in this study uses a hydrodynamic model to simulate hydrodynamics of a particular flood events. There are three reasons to make use of a hydrodynamic model:

- i. To visualize and understand the hydrodynamics of the model.
- ii. To simulate previous flood events.
- iii. To determine the effect of the water-filled mobile flood barrier.

A hydrodynamic model shall be constructed based on field visits, local expertise, and available data. The modeling software used for the hydrodynamic model is 3Di. 3Di is state-of-the-art hydrodynamic simulation software for pluvial, fluvial and coastal floods. 3Di is applied in both urban and rural areas. Unique about 3Di is the combination of fast simulations, interactive modelling, detail of the schematisation and the advanced capabilities to model hydrodynamic processes.

This information service was also used during the pilot project. The hydrodynamic model provided insight in factors that are used to assess flood risks such as: (i) flood depth/extent, (ii) flow direction, (iii) flow velocity and (iv) flood duration. Figure 9 is a visualization of one of the flood scenario's using 3Di.

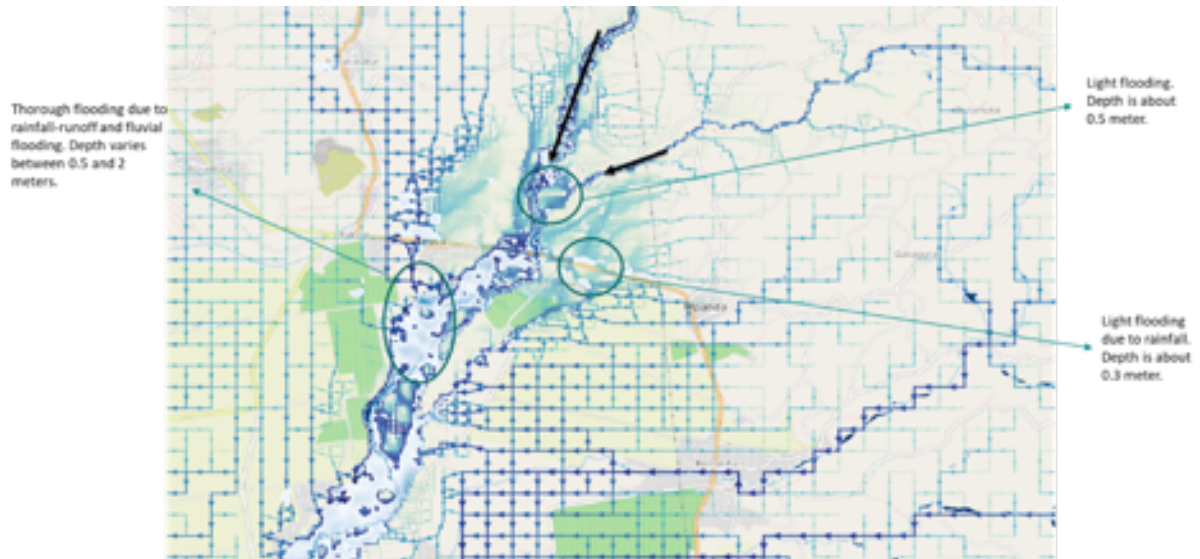


Figure 9: Hydrodynamic model reflecting severity of flooding in Gahwazi (in Mpanda)

The same information service was used to determine where the water-filled mobile flood barrier could be deployed and what its impact would be on a flood event. This information service shall be used as part of the approach to select the right locations and to design the interventions centered around the water-filled mobile flood barrier.

Flood Intelligence Service (FIS) tool

This newly developed information service is built on the 3Di hydrodynamic modeling software. FIS conducts a comparative analysis between a flood event (i) with a resilient measure and (ii) without a resilient measure. The comparative analysis includes a visualization of the flood extent and a calculation of the damages in both situations. The reduced number of damages are the anticipated benefits from the flood intervention(s) during a particular flood event. This helps in decision-making regarding the implementation of flood resilient interventions. FIS therewith improves effectiveness and the cost-efficiency of the implementation of flood resilient measures. The results of the analysis by FIS are reflected in a visualization of the flood damage reduction, graphs, and tables such as the example below. The tables in contain information on damages caused by flooding in the baseline situation, i.e. no resilient measures, and in the benefit situation i.e. including a resilient measure. The differences in damages, i.e. adaptation benefits, are shown in the last column of the table.

Table 2: Example output hypothetical FIS analysis in an urban area

TOPIC	Damage & Casualty		
	BASELINE	AFTER MEASURES	BENEFIT
Residential damage	€ 17,239,128	€ 16,700,405	€ 538,723
Agriculture damage	€ 97,326	€ 97,326	€ 0
Affected people (number of people)	5,641	5,218	423
Affected residential area	217,600 m ²	204,800 m ²	12,800 m ²
Affected agriculture area	204,800 m ²	204,800 m ²	0 m ²

FIS shall be used as part of the feasibility study and beyond to select implementation locations and to design the setup of the water-filled mobile flood barrier. This enhances the effectiveness and cost-efficiency of the implementation of the flood and drought interventions.

Optimal Dam Locator

Building on FIS is an AI-driven information service called the “Optimal Dam Locator”. This information service is used to assess the optimal location to deploy the water-filled mobile flood barrier. This information service recommends where to deploy the water-filled mobile flood barrier at any given area based on specific parameters. The optimal location can be based purely from a cost-efficiency perspective or based on other factors e.g., wanting to protect as many marginalized and vulnerable people as possible. This information service, just like the other information services, must be used in combination with local expertise and local data collection activities. This information service can recommend the optimal location but certain practicalities on the ground might contradict the outcome of this tool. Nevertheless, this information service supports the realization of as many benefits as possible for the different stakeholder groups. As such, this tool shall be used as part of the feasibility study and beyond.

Hydrodynamic modeling software and the corresponding FIS and Optimal Dam Locator tool are used by local and international experts to analyse flood risks and assess the best possible mitigating measures, illustrated with Figure 10.



Figure 10: A control room where software is used for flood and drought analyses

Flood and Drought Early Warning System (FDEWS)

Flood and drought events have exacerbated due to climate change the last decades. Even though flood and drought risks have increased, the number of casualties has decreased in the same period. The main reason for this is that Early Warning Systems (EWSs) increase the adaptive capacity of people and institutions in case there is a threat of flooding or drought. During COP27 (Annual climate convention held in Egypt in 2022), the member states set a goal “to achieve early warning systems for all by 2027”⁴. The in this study includes the implementation of an EWS for both flood and drought events. A flood early warning can be the trigger to deploy the water-filled mobile flood barrier in the selected locations. People and authorities shall monitor the occurrence of flood events and issue warnings in case a threat of flooding has been detected, demonstrated with Figure 11.

⁴ <https://news.un.org/en/story/2022/11/1130277>



Figure 11: Early Warning System (EWS) will be implemented

Once a threat has been detected by relevant authorities, community members (including farmers and pastoralists) are notified by the EWS as demonstrated with Figure 12. This enables them to take the necessary actions in a timely manner to prevent damages caused by flood and drought events.



Figure 12: Local community members receive EWS notification

The EWS is streamlined with the other information services and makes use of the hard- and software implemented as part of the combination of interventions. Correspondingly, a framework shall be designed to ensure there is a common understanding of the EWS process and corresponding roles and responsibilities.

Other hardware and software

The approach furthermore includes other types of hard- and software such as weather stations to collect data. The feasibility study shall assess the different categories of information technology to be included in the design of the programme.

1.1.1.6 Adaptation practices

The portfolio of flood and drought interventions includes a change in practices and behaviors of local stakeholder groups. These changes include new farming practices e.g., by growing crops that are more resilient to drought. Adaptation practices also include improved collaboration between different stakeholder groups at different levels of society to prevent adverse impacts of climate change. The society shall benefit when stakeholder groups in the public and private sector collaborate to mitigate flood and drought risks. The feasibility study assesses the types of practices and behaviors that need to change as part of the stated holistic approach to enhance resilience to flood and drought.

1.1.2 Comparison with alternative interventions

This study assesses how the water-filled mobile flood barrier compares with other flood resilient interventions. Despite that the portfolio of interventions laid out in this study comprises of other products and services, the focus of the comparison in this study is on the water-filled flood barrier. The water-filled mobile flood barrier lies at the heart of the approach and drives the design of the other flood and drought resilient products and services. The comparison is based on an analysis by members of the University of Delft in The Netherlands that aimed to compare the water-filled mobile flood barrier with alternative mitigating measures.

The analysis by the University of Delft confirmed that countries increasingly recommend non-structural flood mitigating measures since these can be more effective than structural mitigating measures. Non-structural measures also have the advantage to generally be less expensive. This study compares the water-filled mobile flood barrier with other flood mitigating measures included in Table 3.

Table 3: Overview flood mitigating measures

Mitigating category / type	Description
1.1.2.1 Emergency measures	
<i>i. Sandbags</i>	One of the most known measures for a temporary flood mitigation is the sandbag which can be deployed when there is a threat of flooding.
<i>ii. 1.2 Flood early warning system (FEWS)</i>	Forecasting of floods is one of the mitigation measures that does not necessarily prevent flooding, however it triggers a response to flood.
<i>iii. Flood Hazard Map</i>	These maps show what areas will inundate during certain rainfall-events and what evacuation routes can be taken in case of need.
1.1.2.2 Infiltration measures	
<i>iv. Infiltration areas</i>	Delay, use, capture or absorb rainwater instead of having the rainwater fall onto impervious surfaces that leads to more overland flow.
<i>v. Forestation</i>	Growth of trees at a wide scale to reduce sedimentation upstream.

Mitigating category / type	Description
1.1.2.3 Structural measures	
vi. <i>Development of drainage systems</i>	Improvement of drainage systems are cleaning of drainage channels, culverts, and side ditches of road to avoid blocking of the waterflow.
vii. <i>Excavation or widening of the riverbed</i>	Excavate a river to create a larger cross-section and therefore a higher flow capacity for water.
viii. <i>Retarding basin or pond</i>	retarding basin can help flatten the hydrograph of the runoff by creating a buffer for water storage.

The following sections describe how the water-filled mobile flood barrier compares with the other flood mitigating measures.

1.1.2.1 Comparison with other emergency measures

One of the water-filled mobile flood barrier's main purposes is that it can be used as an emergency measure in response to sudden rainfall induced floods. Out of the other mitigation measures, (i) sandbags, (ii) a Flood Early Warning System (FEWS) and (iii) the flood hazard map are deemed mitigation measures considering that these can also be used during emergency situations.

Sandbags

Sandbags and the water-filled mobile flood barrier are similar in the sense that both can be deployed not long before a flood event and can be removed once the risk has subdued. The key differences relate to the (i) ease of deployment, (ii) effectiveness, (iii) reusability and (iv) multi-purpose application.

- i. Regarding the ease of deployment: The water-filled mobile flood barrier can be deployed significantly easier and faster. A 100-meter-long mobile flood barrier can be rolled out in approximately one hour by just two persons. In comparison, it takes fourteen people and two hours of time to deploy a 10-meter-long barrier using sandbags of the same height.
- ii. Regarding the effectiveness: Compared to the water-filled mobile flood barrier, sandbags have a greater of failure. The sandbag has four types of 'flood failures', which can be seen in Figure 5 (Lendering, Jonkman, & Kok, 2016). The four types of failure are (Boon, 2007): (i) Overflow, (ii) Sliding, (iii) Rotation and (iv) Seepage (see Figure 13).

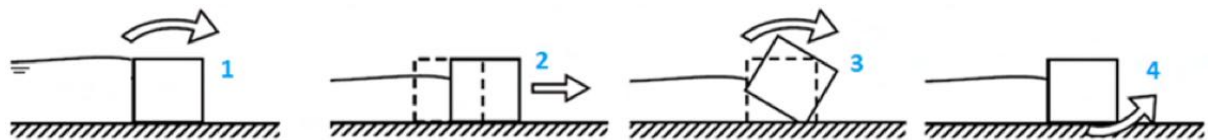


Figure 13: The four types of flood failures for sandbags (Lendering et al., 2016)

- iii. Regarding the reusability: The water-filled mobile flood barrier can be reused after dismantling over the entire lifespan of the technology. Sandbags, in contrast, cannot be reused and take a lot of effort and costs to dismantle.
- iv. Regarding the multi-purpose application: The water-filled mobile flood barrier can be used to realise other benefits that reduced flood damages such as improved water security using the water stored in the flood barrier in times of drought. Sandbags are limited in using it for other purposes than flood prevention.

Flood Early Warning System (FEWS)

A FEWS is also considered to be an emergency measure even though it has to be implemented before the actual flood takes place. A FEWS has the ability to reach many people, which could save more lives compared to the water-filled mobile flood barrier, provided that the community knows how to respond to the warning. Another advantage of the FEWS is that it can gather data which can be used for future floods. The FEWS itself doesn't actively prevent flooding as opposed to the water-filled mobile flood barrier. Both interventions are emergency measures but with a different purpose and are therefore challenging to compare. It's worthwhile to understand the (dis)advantages of both interventions to assess how these differ and how they can complement each other.

Flood Hazard map

Similar to the FEWS, a flood hazard map is challenging to compare with a water-filled mobile flood barrier considering that this too is an intervention that does not directly prevent flooding. A flood hazard map enables authorities and people to predict where floods are likely to take place. One key advantage of the water-filled mobile flood barrier, compared to the flood hazard map, is that it doesn't require high skilled labor to operate. A flood hazard map requires a detailed hydrodynamic model and experts in hydrology who can make these maps. The maps can also get outdated if surroundings like land cover and land use change. Maps therefore need to be updated regularly, whereas the mobile flood barrier can be used during its lifespan. It's worthwhile to understand the (dis)advantages of both interventions to assess how these differ and how they can complement each other.

1.1.2.2 Comparison with infiltration measures

This section compares different infiltration measures with the water-filled mobile flood barrier. The infiltration measures that will be compared are (iv) infiltration areas and (v) forestation.

Infiltration areas

In the field of "infiltration areas" there are different types of solutions that can be used to enhance resilience to flood or drought. Infiltration areas are capable of retaining water; however, the retained water cannot be directly reused. The retained water will be used by vegetation to grow or the water can infiltrate deeper in the ground where it can potentially recharge groundwater. The water-filled flood barrier harnesses water inside the barrier or in a larger water harvesting infrastructure after which it can be reused for irrigation purposes or as drinking water for livestock. An advantage of infiltration areas, compared to the water-filled flood barrier, is that it has the potential to create a cooler environment if it creates a higher albedo since this results in more reflected sunlight (Taha, Akbari, Rosenfeld, & Huang, 1988). A disadvantage of infiltration areas is that it could become saturated, meaning that no water can infiltrate anymore limiting the ability to prevent flooding on that land. A water-filled flood barrier is a modular system with no technical limitation in how long it can become; it can therefore retain as much water as needed.

Forestation

Forestation is quite similar to an infiltration area, however it has a slightly bigger extent to prevent floods. Forestation, if implemented on wide scale, cannot only prevent flooding due to infiltration and interception of rainfall, it can also cause more friction which causes slower overland flow and less accumulated flash floods. Comparisons between the water-filled mobile flood barrier and the forestation lies mostly in the prevention of flooding. Compared to

the water-filled mobile flood barrier, which actively prevents water from overflowing, trees are ineffective in flood prevention aside from the increased level of friction it causes which slows down the velocity of the water stream. Another downside of forestation is that it takes a long time for it to fully develop, which worsens if it gets damaged during the development stage. In contrast, the water-filled flood barrier is a temporary structure which can be developed quickly and does not have a lasting impact on the landscape. Forestation does have other benefits such as: (i) increased biodiversity, (ii) greener area, (iii) attractiveness of tourism increases, and (iv) the water gets purified. There are clear differences between both interventions, however they also have the potential to complement each other.

1.1.2.3 Comparison with structural measures

Structural measures are interventions that need to be constructed and cannot be easily removed; removal can only be done through demolition. Permanent structures cannot be moved and therefore always prevent flooding for the selected area. The water-filled mobile flood barriers, however, prevent flooding only when these are deployed. The water-filled flood barrier easily adapts to changes in landscape (e.g., urbanization) or weather patterns that impact flood patterns. Structural measures don't have the ability to adapt to such changes. This section compares the water-filled flood barrier with the following structural measures: (vi) development of a drainage system, (vii) excavation or widening of the riverbed and (viii) retarding basin or pond.

Development of drainage systems

The development of drainage systems has to be done in case the current system is outdated or not well maintained. A key difference between both interventions is that the development of drainage system can lead to a higher flow capacity. With the water-filled flood barrier the height of the riverbank is increased to prevent flooding. The development of drainage system enables a choice what to adjust enabling the water to be directed away from a certain area. Both interventions can increase the cross-section for the water to flow through resulting in reduced risk of flooding. A key difference is that the development of the drainage system demands continuous maintenance whereas the water-filled flood barrier does not need a lot of maintenance.

Excavation or widening of the river bed

Excavation or widening of the riverbed is a structural measure that results in an enlarged cross-section for the water to flow through. A water-filled flood barrier can heighten the banks meaning that less water will overflow from the river. The key difference is that excavating a river requires a significant amount construction. Land, possibly of farmers or residential areas, has to be removed and this includes removing of vegetation. This intervention must be maintained to uphold the increased cross-section considering that erosion leads to a reduced cross-section after a period. In contrast, a water-filled flood barrier is a temporarily measure which does not change the environment or someone's land. The excavation of a river, however, could mean significantly enlarged cross-sections therewith preventing flood risk more effectively compared to the water-filled flood barrier.

Retarding Basin or Pond

A retarding basin is an area where water can be stored if the capacity of a river cannot sustain the amount of water or if there is a high amount of overland runoff. This basin has to be digged in a certain area or dikes needs to be built to create a buffer zone where the water

can be retained. Just like with a water-filled flood barrier, water will be stored in this mitigation measure and can be used in a later stage. The water could also be directed back to the river system when water levels have decreased. A disadvantage is that the basin has a maximum capacity, whereas the water-filled flood barrier theoretically has infinite storage capacity seeing as it is a modular system that can be expanded. A key difference is also that the water in a retarding basin is exposed to the environment. This leads to an increase in mosquitoes, waterborne diseases, and evaporation of the water. In contrast, the water-filled flood barrier is vapor tight and due to the black exterior the water inside can reach a high temperature which is not favorable for bacterial growth.

1.1.3 Ranking flood mitigation measures

The members of the University of Delft ranked aforementioned flood mitigating measures, including the water-filled mobile flood barrier, using a set of criteria. These criteria are inspired by the OECD (Organization for Economic Cooperation and Development) (1992), for evaluation and comparison of international development projects, which are: (i) Relevance, (ii) Effectiveness, (iii) Sustainability, (iv) Efficiency and (v) Impact. Each of the criteria has multiple sub-criteria.

Each criterium has been given a score for all the mitigating measures, the results of which have been included in a scoring matrix. Each (sub)category can be scored with a 0, 1, 2 or 3 meaning the following:

- A 0-score means that the mitigation measure scores very poorly and therefore no points are given to the mitigation measure. For example if a mitigation measure has a disproportional high maintenance cost this would result in a 0 for that subcategory.
- A 1-score is given if a mitigation measure scores relative poorly in a category. An example would be if a mitigation measure has merely one extra "benefit" in addition to preventing floods such as awareness creation.
- A 2-score is given when a measure scores medium or "okay". An example would be if a mitigation measure realizes benefits related to flood resilience yet has slight impact on the environment.
- A 3-score will be given if a mitigation measure scores very highly for that category. A mitigation measure that would almost certainly result in no floods could score a 3 in "Results (floods)".

Below table is the scoring matrix that reflects the outcome of the ranking of the flood mitigating measures by the University of Delft.

Table 4: Outcome scoring matrix mitigation measures

	Relevance			Effectiveness			Sustainability				Efficiency		Impact		Total	Score out of 10
	Sensitive to situation	Partner/ institution	Beneficiaries	Goals and needs (floods)	Goals and needs (other)	Added benefits	Environmental	Financial (maintenance)	Technological	Institutional/ social	Cost-effectiveness	Time-effectiveness	Extent	Long-term		
1. Water-filled mobile flood barrier	3	2	2	2	2	3	2	3	3	3	2	3	1	2	33	7.857
2. Development of drainage systems	3	3	3	3	1	2	3	1	2	3	2	1	2	2	31	7.381
3. Excavation/ widening of river bed	3	1	1	3	1	0	1	0	1	1	1	1	2	2	18	4.286
4. Retarding Basin/ Pond	2	2	2	2	2	1	1	2	2	2	1	2	2	2	25	5.952
5. Infiltration area	2	2	2	1	3	3	3	2	2	2	1	1	1	3	28	6.667
6. Sandbags	3	1	2	1	0	1	2	2	1	2	2	3	0	1	21	5.000
7. Forestation	1	3	3	1	3	3	3	3	2	3	2	0	1	3	31	7.381
8. Flood early warning system (FEWS)	2	3	2	1	0	2	3	1	2	2	3	3	3	2	29	6.905
9. Flood Hazard map	3	2	1	1	1	1	3	2	2	2	3	2	3	2	28	6.667

Score	
0 =	Bad
1 =	Low
2 =	High
3 =	Very high

The scoring matrix demonstrates that (i) the water-filled mobile flood barrier, (ii) the development of drainage systems, and (iii) forestation score the best in total amount of points. The mitigation measure with the least amount of points is the sandbag. Below section provides a brief explanation of the scoring per category.

Sensitive to situation

In this category it is important that a measure has as main goal to reduce or prevent flood risks. This is why most of the flood mitigation measures score 3 points except for (i) forestation, (ii) infiltration area, and (iii) retarding basin; these mitigation measures do not have flood prevention as the main purpose. These mitigating measures focus more on infiltrating or collecting water and reducing the amount of water flowing through. Despite that a FEWS reduces flood risks, it doesn't score a 3 as it does not directly prevent flooding.

Partner / institution

With this category it is important that a mitigating measure matches the goals and needs for local partners and institutions. The main reason most measures do not score a 3 is because one of the goals is that land is not taken away from local partners, but for most measures this would be the case. Next to this, most needs of institutions were found to be related to drought issues as became clear after asking their main challenges; this results in a higher score for the water infiltrating or retaining measures.

Beneficiaries

This category assesses to what extent the interests of beneficiaries have been taken into consideration. Especially the excavation or widening of the river scores low as this would result in loss of land, which is often used for agricultural purposes. People tend to live in the

riparian land, albeit often illegally; widening of the river would mean they have to move. The flood hazard map scores low because not many people of the community will benefit on a daily base from this measure, but it is especially valuable for e.g. urban planning.

Goals and needs (floods)

The most effective measures to prevent flood damages are (i) excavation or widening of the riverbed and (ii) the development of the drainage system. These measures might prevent flooding altogether. Most other measures score a 1 due to the fact they do have a limited ability to prevent flood damages or they do not directly prevent flooding.

Goals and needs (other)

Other results focus on tackling (climate change-induced) environmental problems such as (i) droughts, (ii) water quality or (iii) rising temperatures. A FEWS gets a 0 as it gives warnings for floods but is not helpful in preventing other risks. Sandbag scores low as well seeing as it prevents floods to a certain extent but does not provide extra benefits. Infiltration areas and forestation score a 3 because these also help in (i) preventing temperature rises, (ii) droughts, (iii) recharging groundwater, (iv) increasing water quality, and (v) reducing the sedimentation transport.

Added benefits

Added benefits include the non-environmental benefits such as (i) cultural, (ii) political, and (iii) economical benefits. This category gets a high score for (i) the water-filled flood barrier, (ii) forestation, and (iii) the infiltration area. Economical growth benefits significantly when water can be used for agricultural purposes and more greenery also benefits mental health (Nutsford, Pearson, & Kingham, 2013). Measures that are already being used will be accepted more easily whereas an excavation or widening of the river would result in political and cultural setback.

Environmental

Environmental sustainability in this context means little to no disruption of the surrounding area where the mitigation measure is to be implemented. The water-filled flood barrier requires no displacement of soil or big trees to be implemented. The reason the barrier scores a 2 instead of a 3 is because, in some cases, it might be needed to remove plants or obstacles to ensure the barrier can be deployed. Excavation or widening of the riverbed and retarding basins require heavy machinery to dig out land in order to give more room for water storage and they may constantly need digging out due to sedimentation. The measures that rank the highest are the non-structural measures, since these require no physical deposition of building materials or displacement of land.

Financial (maintenance)

With this category it is important to assess the maintenance costs; development / manufacturing costs is assessed in the cost-effectiveness category. The excavation scores a 0 as this excavation would need to be maintained yearly and is highly costly. A water-filled mobile flood barrier is only a one-time purchase and could last at least 40 years. Forestation also scores a 3 assuming that any damages can be overcome by nature itself. A FEWS scores a 1 seeing as hardware unfortunately is sometimes damaged or needs upgrading. Development of drainage systems scores a 1 seeing as continuous cleaning of culverts and drainage canals is necessary even though cost of labor can be low.

Technological

The advantage of using the most innovative solutions is that there is a small chance that these need to be replaced or upgraded soon. Aside from (i) excavation or widening of the riverbed and (ii) sandbags, the mitigating measures currently have no direct innovative alternatives, hence the relatively high score for technological sustainability.

Institutional / social

Interventions require support from local stakeholder to ensure these measures are implemented successfully. Excavation or widening of the riverbed requires the displacement of surrounding population to create space for more water to flow. Despite proving to be very effective in mitigating flood risks, this measure can face a lot of backlash from the local landowners. The favored measures are (i) the water-filled mobile flood barriers, (ii) forestation, and (iii) development of drainage systems.

Cost-effectiveness

Only two mitigation measures score a 3, which are the FEWS and the flood hazard maps. Both interventions are relatively inexpensive to built and are highly effective in alerting people and institutions on the timing and location of an upcoming flood event. Both measures can also be used for urban planning. The costs are highest for (i) the retarding basin, (ii) excavation, and (iii) infiltration areas. Compared to other measures that directly prevent flood damages, the water-filled mobile flood barrier has the best Return on Investment (RoI).

Time-effectiveness

Forestation scores a 0 in this category as it can take many years before the vegetation has grown enough to reach its potential to reduce flood risks. Measures that score the highest are (i) the water-filled flood barrier, (ii) sandbags and (iii) the FEWS seeing as these can be implemented almost immediately. The flood hazard maps measure scores a 2 because the research takes time before the maps can be created after which it takes time for urban planning water management to create new plans.

Extent

The most preferable interventions to a community are those which help the largest number of people. The extent of the different mitigation measures varies greatly. Sandbags are heavily localized and only protect an individual or a couple of individuals. The water-filled mobile flood barrier requires many units to protect a considerable number of people or area. Forestation requires planting of large quantities of trees along the river to impact a large group of people. FEWS and flood hazard map are scored high seeing as these require limited extra investments to increase the geographical extent.

Long-term

Reducing flood risks in the long-term can greatly benefit stakeholders. This does not necessarily have to be directly linked to flood prevention but can also mean improved community engagement, increased climate change awareness, and strengthened social equality. Forestation and infiltration areas help in the improving the ecological quality of the surrounding area. The water-filled mobile flood barrier, FEWS, and flood hazard maps raise awareness about the flood and drought problems in the region and require cooperation between different stakeholder groups. Reduced flood risks in the long-term can also lead to improved livelihoods.

Ranking the mitigation measures gives an idea of how valuable mitigating measures can be in flood prevention. Ranking of the measures doesn't necessarily mean that these are mutually exclusive. In fact, the approach in this study aims to leverage FEWS complementary to the water-filled mobile flood barrier.

The feasibility study shall extend the comparison with alternative solutions for the other measures in the approach i.e. (i) water harvesting infrastructure, (ii) solar pumping and irrigation system, solar-powered cold storage, (iv) information technology and (v) adaptation practices.

1.1.3 Expected benefits of this unique combination of adaptation measures

The combination of adaptation measures is designed to realise the most (i) economic, (ii) social, and (iii) environmental benefits especially for the most vulnerable groups. These benefits shall be aligned with national and international (climate) objectives as included in national adaptation plans and strategies. The envisioned benefits from the combination of adaptation measures are described in below paragraphs.

1.1.3.1 Socio-Economic benefits

The portfolio of adaptation measures in this study will directly contribute to improving the populations' livelihoods across the selected sites and even on a national scale, through innovative approaches and measures and income-generating activities. Preventing damages from flooding and improving water security will improve the livelihoods of farmers and pastoralists and by extension vulnerable groups such as women and youth.

Climate change has exacerbated flood and drought events over the last decades; however, the number of casualties and injuries has decreased significantly. One of main reasons for the decrease in human loss is due to the implementation of EWSs. By implementing EWSs and other weather information services, the proposed approach will reduce the number of casualties and injuries.

Promoting smart agriculture practices such as the usage of drought-resistant crops and drought tolerant breeds of livestock will increase production. By aligning production with customer demand, the incomes of farmers and pastoralists will inevitably increase. This will lead an increase in income and to new jobs.

Water harvesting infrastructure ensures access to water in times of drought for irrigation purposes and as drinking water livestock. This helps prevent epidemics and other diseases.

Flood resilient interventions ensure that there will be less inundated agricultural land. In turn, this limits the risk of waterborne diseases. This will also enhance access to infrastructure such as roads for the population to move to other locations or to visit healthcare facilities or schools.

Another benefit from the flood and drought resilient interventions is reduced social unrest, conflicts and, migration of community members seeking water and other sources of livelihoods. These interventions will socially improve people's stability and prevent the necessity to migrate to other regions or countries.

The combination of adaptation measures ensures that the interests of vulnerable groups such as women and youth are at the forefront when designing and implementing the flood and drought resilient solutions. The approach will set targets to ensure that an adequate number of people who represent these vulnerable groups are involved in the design, implementation and execution of the adaptation tools, technologies, and practices.

Overall, the planned interventions provide concrete socio-economic and environmental benefits to ecosystems and populations especially to the vulnerable groups including women and youth. Food security will increase on a national scale and the flood and drought information services aim to have a national reach and therewith enhancing resilience to climate change nationwide. The interventions will not only make the vulnerable and marginalized groups resilient to flood and drought events, but also provide them with concrete benefits such as (i) food and water security, (ii) reduced damages to land, assets, and people and (iii) increase in income and new jobs. An overview of the benefits is provided in Annex 1.

The feasibility study shall assess the possibility to setup local facilities or teams to manufacture/operate/maintain innovative tools and technologies. For example, there is an option to setup a local facility to assemble/produce the water-filled mobile flood barrier. This would create new jobs.

1.1.3.2 Environmental benefits

The portfolio of adaptation measures will have a positive impact on the (i) protection, (ii) restoration, and (iii) management of the natural ecosystem. The combination of information technology services with technological interventions will reduce the vulnerability to climate change-induced flood and drought. Enhanced information management and improved flood protection, water harvesting, and irrigation systems will be embedded in contingency plans/emergency plans. The approach includes the development of specific contingency plans based on the analysis of the vulnerabilities of ecosystems and populations.

The adaptation measures shall increase awareness amongst the population and institutions on the necessity and method to protect, restore and manage the environment in a sustainable manner. It is imperative that the approach creates awareness and conveys the message that benefits for the environment and socio-economic benefits are intertwined.

The development or improvement of flood and drought risk management plans will give clarity on how resilience is established among different stakeholder groups at all levels of society. These plans reflect the processes and roles and responsibilities to manage flood and drought risks. Benefits to the environment will explicitly be included in the plans to ensure that the population and institutions follow-through with their behaviors and practices to realise benefits for the environment and biodiversity.

The implementation of physical technologies such as water-filled mobile flood barriers and climate smart agriculture practices will result in concrete benefits for the environment and biodiversity. Flood protection prevents (agricultural) land from being inundated, which normally causes damages to the environment. Smart agriculture practices ensure that farmers and pastoralists utilize natural resources to limit the impact on the environment and biodiversity.

The combination of adaptation measures shall enhance water availability for the population, for livestock and to irrigate agricultural land. Water security is essential for a flourishing environment and biodiversity. Efficient use of water ensures there is little waste and increases the ability to meet the demand.

The portfolio of innovative flood and drought resilient measures and supporting risk management plans can become a blueprint for other regions/countries to protect, restore and manage the environment. The design of the programme shall specify what the benefits are to the environment. The interventions and their positive impact on the environment and biodiversity will be communicated to stakeholder groups in Burundi and possibly other (neighboring) countries to determine whether other regions can also realise such a positive impact. The programme shall organize workshops, lessons learned sessions, webinars, field visits and other means of knowledge sharing and awareness-raising to showcase the environmental benefits. The goal is to spread the usage of the practices, tools, and technologies to protect, restore and manage the environment and biodiversity.

The adaptation measures shall be aligned with relevant policies such as the Environmental and Social Policy (ESP), the Environmental and Social Impact Assessment (ESIA) and the Gender Policy (GP) of the Adaptation Fund, one of the potential donors.

1.1.3.3 Benefit indicators

The adaptation measures are an excellent opportunity to address variety of needs. It is imperative for the success of the programme that indicators are defined, and a Monitoring & Evaluation (M&E) framework is established to measure the impact of the interventions.

The impact evaluation relies on the adoption of quantitative and qualitative impact indicators. These serve as means for assessing the progress of an adopted pathway targeted at achieving specific objectives. The table below provides a list of potential Key Performance Indicators (KPIs) that can help to monitor the performance and impact of the adaptation measures toward the local needs that have been formulated by local stakeholders.

Table 5: Overview benefit indicators

Benefit Area	Indicators	Unit
Physical and natural assets made more resilient to climate induced flooding	Total area directly benefiting from more resilient physical and natural assets	(Km ² / USD)
	Agricultural landscape protected from flood damage	(Km ² / USD)
	Urban landscape protected from flood damage	(Km ² / USD)
	Rural landscape protected from flood damage	(Km ² / USD)
	Residential houses protected from flood damage	(Number / USD)
	Public buildings protected from flood damage	(Number / USD)
	Industrial or commercial units protected from flood damage	(Number / USD)
	Small businesses / shops protected from flood damage	(Number / USD)
	Irrigation or water structures protected from flood damage	(Number / USD)
	Ports or landing sites protected from flood damage	(Number / USD) Indirect (USD)

Benefit Area	Indicators	Unit
	Airports protected from flood damage	Damage (USD) prevented
		Indirect (USD)
	Roads protected from flood damage	(Km / USD)
		Number individuals
	km rail networks protected from flood damage	Repair costs (USD) avoided
Affected individuals prevented		
Livelihoods and sources of income of vulnerable populations diversified and strengthened	Total no. of direct beneficiaries with diversified and strengthened livelihoods and sources of income	Number
	Male	Number
	Female	Number
	Reduction in No. people displaced / migrated	Number
	Reduction in No. injuries and deaths	Number
	Reduction in No. jobs lost	Number
	Other	
The number of people who are warned in advance of climatic induced floods and drought grows and the warning consistency and reliability is increased	Total no. of direct beneficiaries from the new/improved climate information systems	Number
	No. of Climate hazards addressed compared to before	Number
	No. of people who are warned for climate risks in advance	Number
	Increase in percentage of uptime of weather information system	Percentage uptime
	No. of correct warnings issued	Percentage
	No. of people who have become more aware of their climate risks	Number
	Hours between warning issue and climate disaster (lead-time)	Hours
	No. of platforms to disseminate climate warnings has increased	Number
Vulnerable natural ecosystems strengthened in response to climate change impacts	Vulnerable ecosystem protected	Protected area (ha)
Active, skilled and materialised local flood and drought response team	Total no. of direct beneficiaries from more resilient physical and natural assets	Number of people
	Km mobile flood barrier	Km.
	Litre water that can be stored in the mobile barrier	Liter
	People trained on how to operate and maintain the flood barrier	Number of people
	Strategically located storage facilities	Number
Number of people trained and informed regarding climate change impacts and appropriate adaptation responses	People are trained and informed regarding climate change impacts	number of people
		Number of people
		Number of people
	People at line ministries are trained and informed regarding climate change impacts	Number of people
Community / association members trained and informed regarding climate change impacts	Number of people	

Benefit Area	Indicators	Unit
	Extension service officers trained and informed regarding climate change impacts	Number of people
	Hydromet and disaster risk management agency staff trained and informed regarding climate change impacts	Number of people
	Small private business owners trained and informed regarding climate change impacts	Number of people
	Schoolchildren, university students or teachers trained and informed regarding climate change impacts	Number of people
	Other (specify)	Number of people

As part of the feasibility study, the indicators will be expanded upon in agreement with stakeholder groups. The values of the indicators, i.e. targets, shall be defined during the next phases.

1.1.4 Adaptation Benefits Mechanism (ABM) methodology

An Adaptation Benefits Mechanism (ABM) methodology will be applied to measure and monitor the anticipated and realised Adaptation Benefits (ABs) from implementing the adaptation measures. This methodology is based on scientific research and enables reliable and verifiable estimation of the ABs anticipated from the portfolio of flood and drought resilient measures. For a great part, the ABs pertain to the reduced flood and drought damages from the implementation of the interventions. This methodology comprises of a baseline methodology and a monitoring methodology.

Measuring ABs is supported by one of the innovative adaptation measures in this study, being the newly developed Flood Intelligence Service (FIS) tool. This software calculates the ABs from flood resilient interventions expressed in monetary and non-monetary values. ABs are derived from comparing a baseline situation, i.e. no resilient measure(s), with a benefit scenario i.e. including resilient measure(s). Additional information services and toolkits support measuring and monitoring adaptation benefits. The ABM methodology and supporting tools allow to measure and monitor ABs specifically for vulnerable and marginalized groups including women and youth. The figure below demonstrates how the flood extent reduces with the deployment of the flood barrier therewith realizing ABs.



Figure 14: Baseline scenario (1), positioning of flood barrier (2) and benefit scenario (3)

The ABM methodology shall also reflect the costs of the interventions. The costs shall be linked to the anticipated and realised ABs. This provides insight in what ABs can be expected from a certain investment in these measures. This improves the ability to upscale

this portfolio of adaptation measures. Investors have insight in what they can expect in return of their investments in the adaptation measures.

The feasibility study shall develop/augment and apply the ABM methodology to define the value of the anticipated benefits from implementing the combination of resilient measures at the selected location(s). This analysis is used to select the right locations to implement the adaptation measures.

1.2 Financing this combination of adaptation measures

Investments in the adaptation measures in this study must result in benefits for local stakeholders such as communities and vulnerable and marginalized groups. Aforementioned ABM methodology can help in mobilizing funding from private and public investors. Donor funding is especially needed in developing countries.

The proposed programme aims to implement these interventions using funding provided by the Adaptation Fund (AF). This programme requires an investment worth USD 5 MIO and shall be a standalone programme financed by the AF. However, the different adaptation measures are highly scalable and there is a great need for these measures in the country. The aim is therefore to expand the budget to realise more benefits for the country. As part of the feasibility study, other potential donors shall be consulted to co-finance a programme that centers around the adaptation measures. The programme funded by the AF is not depended on other sources of funding and can therefore continue even in case there is no co-financing.

Programmes in Burundi that focus on flood and drought risk management often have a budget that well exceeds USD 10 MIO. Even though these programmes have a different scope and different types of measures, it is indicative that managing flood and drought risks has a high priority for the country.

The cost of the combination of adaptation measures in this study depends on many variables, such as the cost of work, materials, the size of the proposed interventions and their specific location, maintenance and operation costs, etc. The programme costs shall be specified at a granular level during the next phases using the information gathered during the feasibility study.

The programme shall also define the financing mechanism to finance activities after completion of the programme. At the heart of the mechanism is a specification of the costs of upholding the implemented tools, technologies, and practices as part of this programme. Agreements shall be made with institutions to ensure financial resources are available to support activities such as maintenance costs. An agreed financing mechanism must be in place to ensure sustainability of the programme.

1.3 Methodology

This study relies to a great deal on the completed pilot project in Burundi in 2022 even though the scope wasn't as broad as the combination of interventions in this study. The same local and foreign team members and tooling were involved in completing this study. This study utilizes the same tooling but expanded the scope by gathering information from other secondary sources such as (i) laws and regulation, (ii) scientific reports and (iii) news

sources. The methodology in this study followed a participatory approach to ensure input from many different stakeholders are considered in this study. The result is a (sub-)catchment level pre-feasibility study that centers around the portfolio of adaptation interventions suitable for development and financing. Furthermore, the result is a description and planning of the feasibility study.

The methodology addresses key barriers hindering investments in the interventions at scale, including: (i) cost and complexity of project origination, (ii) bankability, (iii) governance, (iv) regulation and (v) local capacity. Below is an overview of the key activities that have been performed under the study and which are a basis for the outcomes and recommendations.

Desk-based research and collection of data

- Baseline assessment of the characterisation of the Imbo Basin.
- Gathering information on the ecosystem types present in the area.
- Identification of flood and drought planned and ongoing projects in the country.
- Collection of available hydrological data in the Imbo basin.

Mapping and analysis

- Identifying stakeholders that have a stake in improving flood and drought risk.
- Identifying partners to take programme preparation forward.
- Establishment of collaborations with local entities.
- Mapping national and international policies, legal frameworks at national and sub-national level.
- Mapping roles and responsibilities for relevant institutional arrangements.

Workshops and interviews

- Organisation of interviews with local stakeholder groups including representatives of vulnerable groups such as women.
- Preparation co-design workshops to ensure the adaptation measures are designed following participatory approach using the input from different stakeholder groups.
- Identification of needs and concerns and building trust relationships.

Assessment

- Establishment of an expert group dealing with technicalities.
- Selection of site(s) for possible implementation of adaptation interventions.
- Flood risk modelling for selected sub-basins.
- Prioritization of the interventions to be implemented in the selected locations.
- Assessment of benefits of the adaptation interventions and their feasibility.

2. Flood and drought related challenges in the Imbo Basin in Burundi

Burundi is a small, landlocked country with abundant natural resources, especially minerals and hydropower potential, but years of conflict have severely damaged its economic structure and contributed to widespread poverty^{5 6}.

⁵ NABC (2013): Burundi Business Fact Sheet

⁶ World Bank Climate Change Knowledge Portal, Burundi http://sdwebx.worldbank.org/climateportal/countryprofile/home.cfm?page=country_profile&CCCode=BDI

The country and its people are strongly dependent on climate sensitive economic sectors such as agriculture (mainly rain-fed) and animal husbandry. Agriculture contributes 39.2% to the country's GDP, occupying almost 94% of the working population⁷. Agriculture exports (coffee, tea, cotton) provide all but a small percentage of export revenues⁸.

In Burundi, women make up 56% of the agricultural workforce. Although rural women and men may play complementary roles in farming activities, women tend to play a greater role in natural resource management and ensuring nutrition in the household. Responsibility for climate change adaptation is likely to fall on their shoulders, including finding alternative ways to feed and provide water for their families⁹.

Burundi's annual population growth, 3.1%¹⁰, is among the highest in the world. The country's population is projected to more than double by 2050. With an average density of more than 400 people per square kilometre, Burundi is the second most densely populated country in Sub-Saharan Africa. Population densities vary across the country¹¹. The eastern part of the country has the lowest density, while population densities of 500–2,000 inhabitants per square kilometre occur in the capital, Bujumbura, and the main cities, such as Ngozi and Kayanza in the north, Gitega in the midlands, and Rumonge in the south¹².

Ranking in the bottom five countries of the Human Development Index, poverty is widespread, with 90-95% of the population living on less than USD 2 per day, particularly in rural areas. Burundi is considered the world's hungriest country with almost 40% of its country in need of food¹³. When coupled with intermittent droughts, food shortages deepen and urban migration increases. Although this situation is present throughout Burundi, it is profound in Cibitoke, Bubanza and Bujumbura Rural provinces¹⁴.

Burundi has been characterised as one of the countries in the region that are 'less actively engaged' in climate change adaptation. This is the result of national priorities and national capacities¹⁵ and more recently the political crisis which has also resulted in a decline of opportunities for financial and technical support. Burundi has prepared national strategies and policies for climate change and participated in the UNFCCC conferences and agreements.

2.1 Flood and drought related challenges

The main physical features of the country include a variety of ecological regions. These include Imbo region, which comprises lowlands in the western parts of the country. Generally, Burundi lies in high altitudes that range from 774m to 2,670m above sea level (see Figure 15).

⁷ CIA World Factbook (2015). Available via <https://www.cia.gov/library/publications/the-world-factbook/geos/by.html>

⁸ Burundi Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

⁹ Brody et al., 2008, p. 4, in Nabalamba, A., Mubila, M., Alexander, P. (2011): Climate Change, Gender and Development in Africa. African Development Bank

¹⁰ World Bank Data – Population growth (2016) <http://data.worldbank.org/indicator/SP.POP.GROW/countries>

¹¹ Burundi Ministry of Finance, 2007 in Baramburiye et al. (2013)

¹² Baramburiye et al. (2013)

¹³ World Population Review – Burundi. <http://worldpopulationreview.com/countries/burundi-population/>

¹⁴ These provinces are the targeted provinces of Netherlands bilateral food security programme. Embassy of the Kingdom of the Netherlands (EKN) 2013. Multiannual Strategic Plan (2014-2017).

¹⁵ Hove, H.; Echeverría, D.; Parry, J.E. (2011): Review of Current and Planned Adaptation Action: East Africa. Adaptation Partnership / International Institute for Sustainable Development. https://www.iisd.org/pdf/2011/East_Africa_Adaptation_Action.pdf

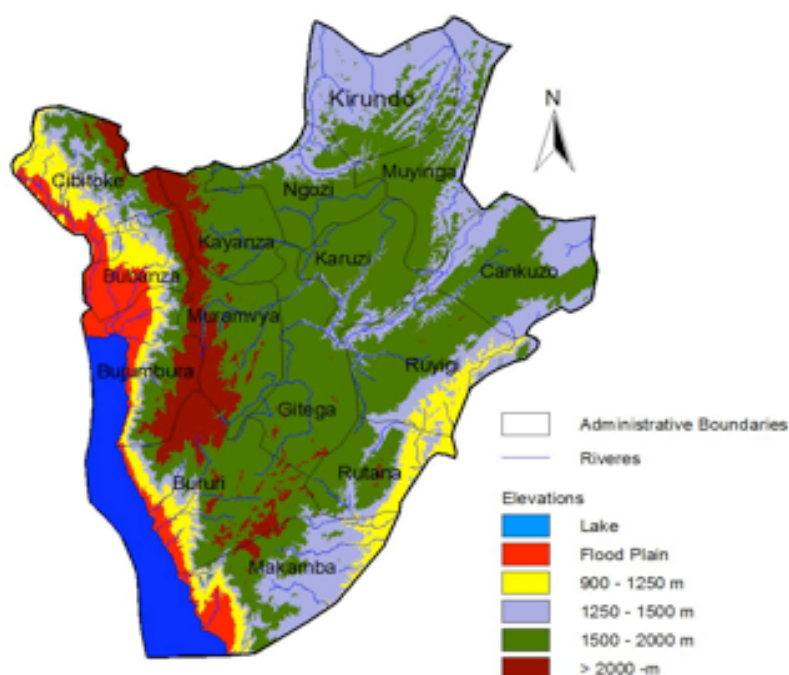


Figure 15: Main physical features and flood risk map of Burundi¹⁶

Burundi has a “moderate” tropical climate with average temperatures between 16°C and 25°C. In the west parts of the country where it is hotter, average temperatures are about 25°C. The country has two major seasons: the dry season from June to September and the rainy season from September to May. The rainy season is made up with two parts, a short rain season from September to December. Between January and February there is a short dry season with frequent dry spells. From mid-February to May there is a long rain season. The distribution of the rains during the rainy seasons is irregular with the highest amounts in the northwest. Dry seasons vary in length, and there are sometimes long periods of drought. However, four seasons can be distinguished: the long dry season (June–August), the short-wet season (September–December), the short dry season (mid-January–mid February), and the long-wet season (February–May). Most of Burundi receives between 1,300 and 1,600 mm of rainfall a year. The Ruzizi Plain in the West and the northeast receive between 700 and 1,000 mm. In some areas, the amount of rainfall received during the short rains is more than that received in the long rains season. The rainy seasons are separated by dry periods in January and June to mid-September. The vegetation is lush and agriculture important.

2.2 Factors contributing to flood and drought in Burundi

The climate in Burundi is mainly influenced by (i) the North-South movement of the Inter-Tropical Convergence Zone (ITCZ), (ii) the topography of the country and (iii) the El-Nino southern oscillation (ENSO)¹⁷. The rainfall depicts very strong seasonality in harmony with the meridional migration of the ITCZ, which is the main weather system generating rainfall over the country. The Congo airmass is another system, which has influence on rainfall over the country through the advection of its moist air. The seasonal rainfall patterns exhibit highly bimodal regimes. The rainfall peaks are generally concentrated in the months of March-May

¹⁶ <https://www.weadapt.org/sites/weadapt.org/files/legacy-new/placemarks/files/506054d92b52bburundi-download.pdf>

¹⁷ <https://www.weadapt.org/sites/weadapt.org/files/legacy-new/knowledge-base/files/505c60bd14a70burundi-climate-final.pdf>

and October-November. The two rainy seasons are referred to as the long and short rainfall seasons. In some cases, however, short rainfall season is more significant. Figure 16 depicts the climatological zones of Burundi.

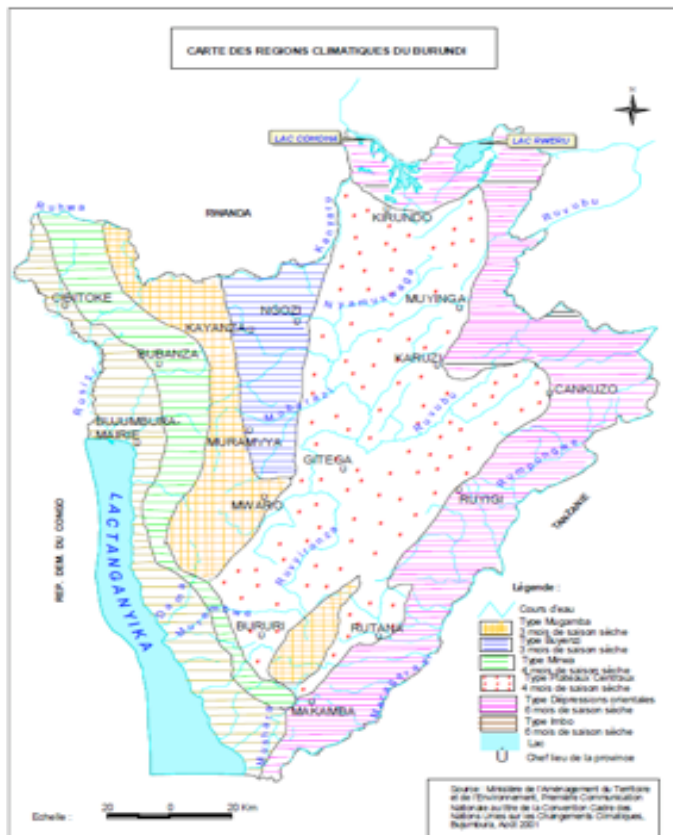


Figure 16: Burundi Climatological zones¹⁸

Currently, smallholder farmers within the upper and mid catchment areas of the Imbo and Moso Basins practice minimal soil and water conservation practices, and several barriers impede them to adopt more sustainable practices¹⁹:

Social barriers

- Limited awareness of more sustainable practices.
- Cultural norms.

Financial barriers

- Limited financial base to invest in these practices.
- Limited financial literacy and access to financial services.

Regulatory barriers

- Insufficient regulatory framework.
- Limited incentives for soil and water conservation.

Institutional barriers

¹⁸ NAPA Burundi 2007

¹⁹ <https://www.greenclimate.fund/sites/default/files/document/sap017-ifad-burundi.pdf>

- Limited institutional capacity to provide necessary technical and material support to farmers upstream.
- Limited site-specific R&D.

2.3 Impact climate change

Burundi has a history of extreme events that are considered climate related. Historically, various zones experienced frequent famines and destructive hailstorms. The regions struck hardest by such events are shown in Figure 17, which is Adapted from FEWS NET and USAID (2009): Livelihoods zoning “plus” activity in Burundi):

- BI01 (Buragane): droughts and erosion²⁰.
- BI03 (eastern depressions) north, BI04 (northern depressions) and BI09 (dry eastern plateaus) north:
 - Frequent and severe droughts and famines (several per decade) – in BI04 combined with regression of lake levels.
 - Since 1999, frequent violent rains, causing erosion, combined with thunder and lightning.
- BI07 (Imbo plains) north:
 - frequent excessive rains, causing floods and occasionally significant increases in the water level of Lake Tanganyika;
 - frequent rainfall shortages.

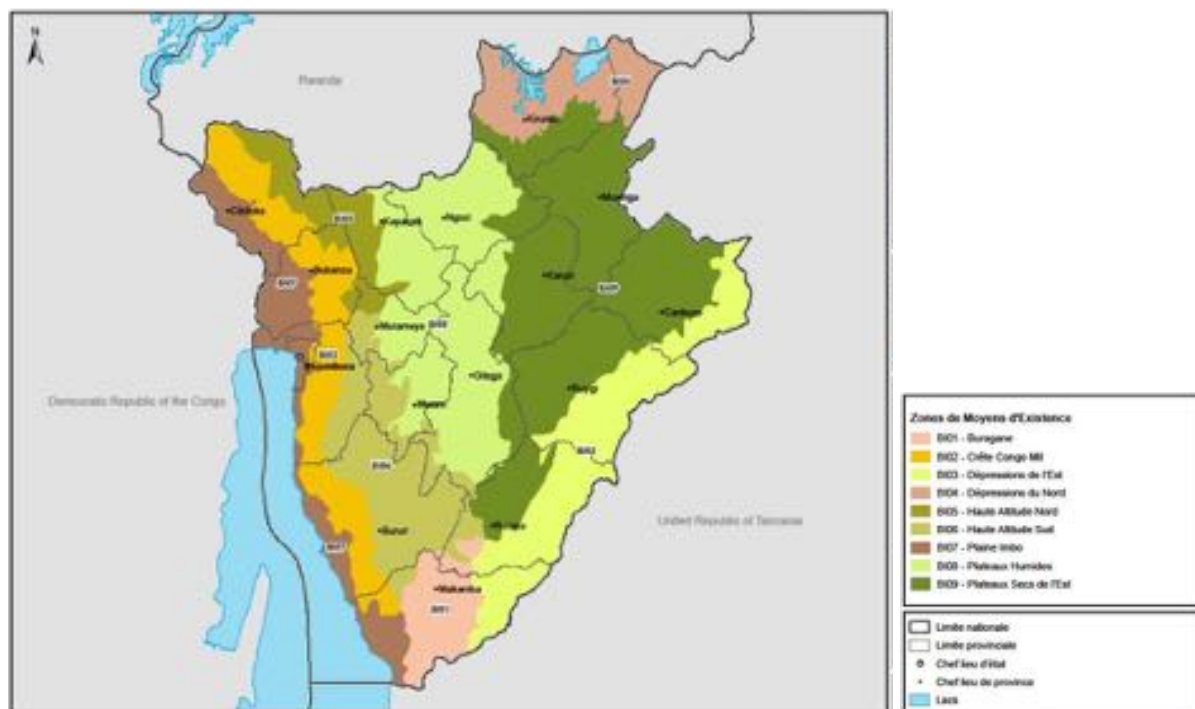


Figure 17: Zones most at risk due to climate change

²⁰ FEWS NET and USAID (2009)

Projections for future changes in temperature due to climate change estimate an increase of 0.4°C per decade²¹ and a 1.9°C increase by 2050²². Projections suggest the following²³:

- A reduction in precipitation is expected for May (end of rainy season) and October (beginning of rainy season).
- Most models project there will be a slight increase in days with 'heavy' rain by 2100.
- An increase of drought is expected in the northern part of the country that will cause a decrease in water levels in the northern lakes.
- Floods are expected to increase in frequency and magnitude in the low-lying areas (e.g. Imbo floodplain).
- Models project an increase in the number of 'hot' days per year for 2046-2065 and 2081-2100 under the low and high emissions scenarios.
- Droughts are expected to become more intense and more frequent, occurring between 40 and 60% of the time.

These projections imply that the long dry season is not only being prolonged as a consequence of climate change, but also receives less rainfall and faces the most significant temperature increase resulting in acute problems for food security and water availability. In addition to losses in agricultural production resulting from the absence of the short rainy season and harnessing of wetlands during the long dry season, (i) pastoral vegetation, (ii) the quality and quantity of fodder, (iii) the duration of the season of vegetable growth, (iv) the animal productivity and (v) water quality are also likely to be affected as climate change progresses.

The northern and eastern provinces, that already suffer from frequent droughts, are likely to see a decrease in annual precipitation, and the projected increases in total rainfall (of 200 mm annually) or in rainfall intensity are not only likely as noted above to cause floods in the western Imbo plains but also erosion in the southern zone and central plateau. See also Figures 18 and 19 for information on changes in precipitation and drought vulnerability.

²¹ Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

²² Climate Change Knowledge Portal. Available via: http://sdwebx.worldbank.org/climateportal/countryprofile/home.cfm?page=country_profile&CCCode=BDI&ThisTab=ClimateFuture

²³ World Bank Climate Change Knowledge Portal, Burundi. http://sdwebx.worldbank.org/climateportal/countryprofile/home.cfm?page=country_profile&CCCode=BDI

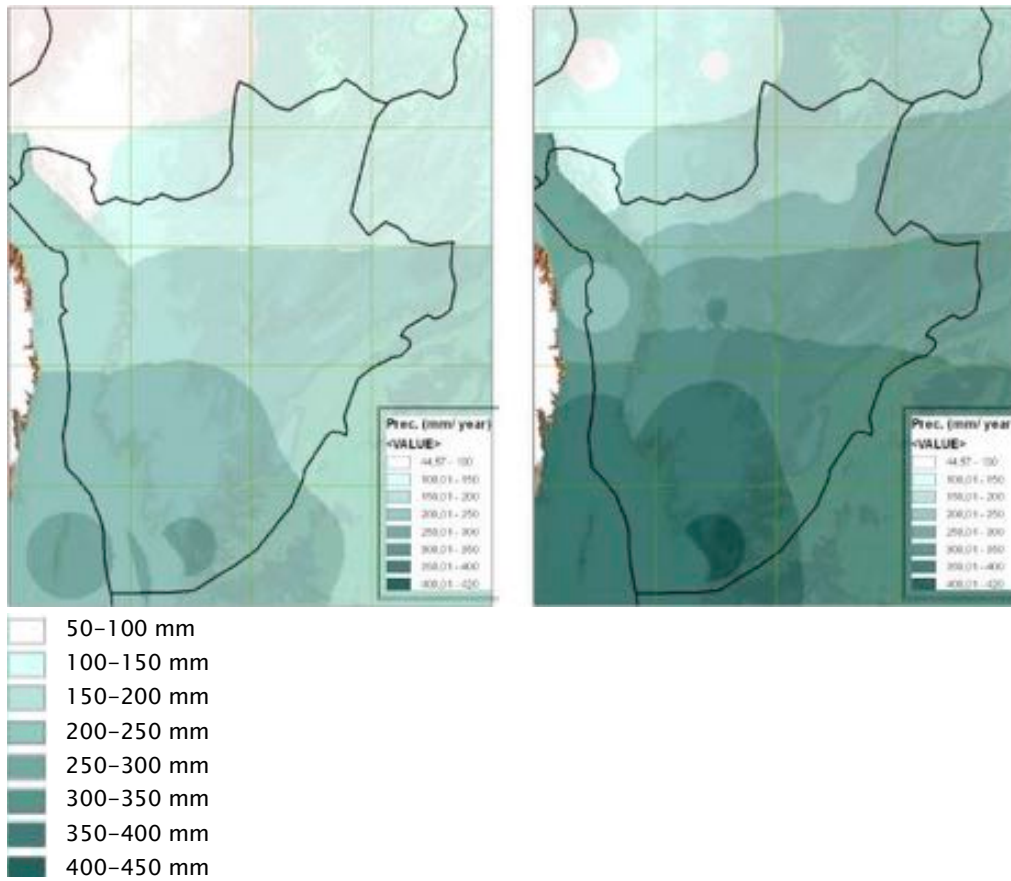


Figure 18: Projected annual rainfall, 2031-2060 (left) and 2071-2099 (right)²⁴

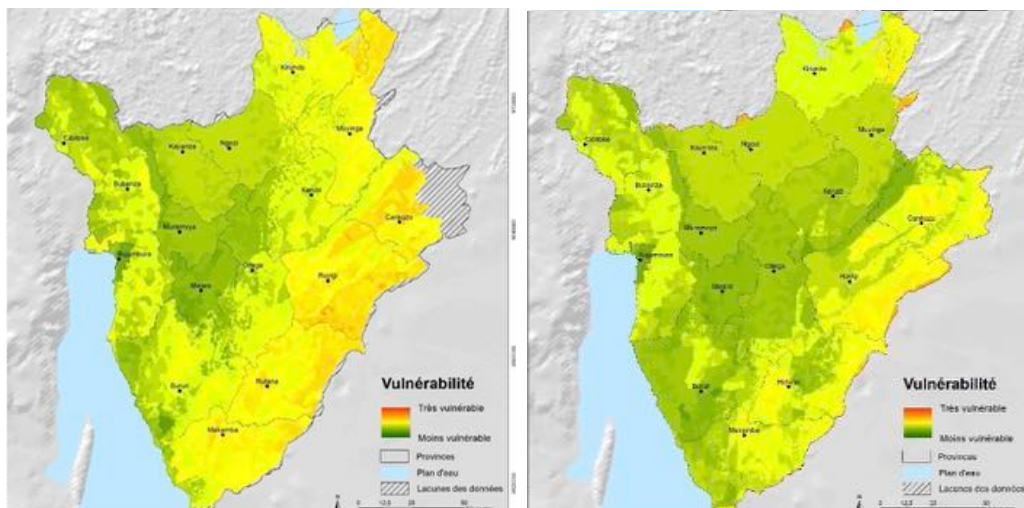


Figure 19: Vulnerability to drought in 2014 (left) and 2071-2099 (right)²⁵

Under current climate change trends there will be a significant impact on some of the principal food and commercial crops in Burundi. The main staple crops are bananas, cassava, sweet potatoes, and beans. Maize (a secondary staple crop), beans and sweet

²⁴ Bollin, C.; K. Fritzsche; S. Ruzima; S. Schneiderbauer; D. Becker; L. Pedoth; S. Liersch (2014): (2014): Analyse intégrée de la Vulnérabilité au Burundi, GIZ and MEEATU & MINAGRI

²⁵ Bollin et al. (2014)

potato yields are expected to decrease gradually, with maize yield decreases of 5-25% predicted for the next decades²⁶. Rising temperatures and erratic or lower rainfall will have a negative impact on Burundi's primary exports of coffee and tea, which account for 90% of foreign exchange earnings²⁷. Extreme floods and droughts are estimated to result in a reduction of long-term growth by 2.4% of GDP per year²⁸.

3. Regulatory framework, institutional roles & responsibilities, and stakeholder analysis

3.1 Regulatory Framework: Strategies, Policies and Plans

A key underlying objective of the programme is the promotion of a large-scale uptake of the portfolio of adaptation measures, centered around the water-filled flood barrier. The adaptation measures contribute to realization of the sustainability objectives by reducing flood and drought risks. Flood and drought risk reduction activities are aligned with international and national strategic objectives of Burundi. This study therefore assessed the national and sub-national strategies, policies and plans that can have an impact on the programme and its activities.

Despite that Burundi has been characterized as one of the countries in the region that are 'less actively engaged' in climate change adaptation, the country has prepared national strategies and policies for climate change and participated in the United Nations Framework Convention on Climate Change (UNFCCC) conferences and agreements.

Burundi has ratified (i) the United Nations (UN) Convention on Biological Diversity (CBD) for which it elaborated a Biological Diversity National Strategy and Plan of Action, (ii) the Convention to Combat Desertification (CCD) for which it elaborated a National Plan of Action to Combat Desertification, (iii) the Framework Convention on Climate Change (UNFCCC) and (iv) the Kyoto Protocol. Burundi signed the Paris Agreement in April 2016 and ratified the agreement in January 2018 with it entering into force in February 2018; see Nationally Determined Contributions (NDCs) below. It has prepared two National Communications for the UNFCCC and a National Action Plan for Adaptation (NAPA)²⁹. The programme contributes to the following priorities of Burundi's NAPA:

- Install mechanisms to control erosion in sensitive areas.
- Control the river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura.
- Popularise short cycle and dryness resistant food crops.
- Popularise rainwater harvesting techniques for agricultural or domestic use
- Establish and protect strategic buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera.
- Train and inform the decision makers and other partners, including the local communities on the methods of adaptation to climate variability.
- Improve seasonal early warning climate forecasts.

²⁶ Baramburiye et al. (2013)

²⁷ Ross, P (2015) Climate Change Effects On Coffee Production: How Hotter Weather Is Killing The Global Arabica Bean Market <http://www.ibtimes.com/climate-change-effects-coffee-production-how-hotter-weather-killing-global-arabica-1905151>

²⁸ DFID (2011): The economic impacts of climate change in Burundi. <http://weadapt.org/knowledge-base/economics-of-adaptation/economics-of-adaptation-burundi>

²⁹ Burundi Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

In 2012, Burundi finalised its National Climate Change Strategy and Action Plan³⁰. Early 2015, Burundi published a report on its progress on activities under the Hyogo framework for action. Three areas were identified as priorities for the future to which FDR1 will contribute:

- Integrate disaster risk reduction into policies and plans for sustainable development.
- Develop and strengthen institutions, mechanisms and capacities to build resilience to hazards.
- Systematically consider risk reduction in emergency preparedness/response/recovery activities³¹.

Burundi submitted its First NDC in January 2018 to the UNFCCC³². In its NDC Burundi presents itself as being vulnerable to climate change. It projects that climate change affects every economic sector in the country but will particularly impact agriculture and hinder the development of hydropower. To successfully adapt to climate change, Burundi's NDC proposes to prioritise actions that reflect the priorities identified in its National Strategy and Action Plan on Climate Change (2012); FDR1 contributes to many of these priorities:

- Integrated management of climate risk and forecasts over time (by means of probabilities and forward-looking studies) so as to be able to take action in advance.
- Protection of aquatic and land-based ecosystems.
- Coaching of the population to develop their resilience to climate change.
- Development of institutional and operational capacities to coordinate programmes that are resilient to climate change.
- Establishment of functional monitoring and evaluation mechanisms for climate change, as well as knowledge management and information mechanisms.
- Enhancement of data and information management and distribution mechanisms.
- Reinforcement of climate change impact tracking systems by means of observations and investigations.
- Strengthening of the information and data communication and exchange system.

Burundi has ratified a Technology Needs Assessment (TNA) and a Technology Action Plan (TAP) related to climate adaptation. The TNA states that sectors most vulnerable to climate change agriculture comes first, followed by the water resources, energy, environment, and natural ecosystems sectors. It is for this reason that the Agriculture and Livestock sector and the water resources sector have been selected as priority sectors in the TNA for adaptation to climate change. Three technologies in the Water Resources sector and three technologies in the Agriculture and Livestock sector have been defined which are deemed "high priority" for the country. The high priority technologies in the Water Resources sector center around: (i) monitoring water quantities, (ii) harnessing rainwater and (iii) control of the rain dynamics. The high priority technologies in the Agriculture and Livestock sector center around (i) soil conservation systems, (ii) development of the short cycle rice variety and (iii) community early warning systems. The TAP of Burundi defines the technologies and projects that are being implemented to meet the high priority technical needs. The activities of the proposed programme are fully in line with the high priorities as stipulated in the TNA and the TAP. The programme shall align with the TNA and the TAP and ensure there is no duplication.

³⁰ Nile Basin Initiative (2013): Climate Change Strategy. www.nilebasin.org/index.php/media-center/publications/doc_download/104-nbi-climate-change-strategy

³¹ HFA (2015): Burundi - Rapport national de suivi sur la mise en oeuvre du Cadre d'action de Hyogo (2013-2015) - Interim

³² The First NDC is the INDC that was submitted to September 2015 prior to the Paris COP

The table below reflects the national and sub-national strategies, policies and plans related to climate change in the water sector and their priorities.

Table 6: Overview strategies and plans related to the interventions

Strategy/plan/programme	Year published	Priorities
1. Strategic plan: National Action Plan for Adaptation (NAPA) ³³	2007	<ul style="list-style-type: none"> • Control the river dynamics of watercourses and torrents in Mimirwa, including the city of Bujumbura. • Popularise short cycle and dryness resistant food crops. • Popularise rainwater harvesting techniques for agricultural or domestic use. • Train and inform the decision makers and other partners, including the local communities on the methods of adaptation to climate variability. • Improve seasonal early warning climate forecasts.
2. Strategic plan: National Climate Change Strategy and Action Plan ³⁴	2012	<ul style="list-style-type: none"> • Integrate disaster risk reduction into policies and plans for sustainable development. • Develop and strengthen institutions, mechanisms and capacities to build resilience to hazards. • Systematically consider risk reduction in emergency preparedness/response/recovery activities.
3. Strategic plan: Nationally Determined Contributions (NDC) ³⁵ / National Strategy and Action Plan on Climate Change (2012)	2021	<p><i>Climate risk adaptation and management.</i></p> <ul style="list-style-type: none"> • Integrated water resources management by a small hydrological unit. • Integrated management of climate risk and forecasts over time (by means of probabilities and forward-looking studies) so as to be able to take action in advance. • Protection of aquatic and land-based ecosystems. • Coaching of the population to develop their resilience to climate change. • Establishment of functional monitoring and evaluation mechanisms for climate change, as well as knowledge management and information mechanisms. • Promotion of climate-smart agriculture (agrometeorology).
		<p><i>Capacity-building, knowledge management and communication.</i></p> <ul style="list-style-type: none"> • Enhancement of data and information management and distribution mechanisms. • Strengthening of the information and data communication and exchange system.

³³ Burundi Ministry for Land Management, Tourism and Environment (2007), in Baramburiye et al. (2013)

³⁴ Nile Basin Initiative (2013): Climate Change Strategy. www.nilebasin.org/index.php/media-center/publications/doc_download/104-nbi-climate-change-strategy.

³⁵ Republic of Burundi (2018). Nationally Determined Contribution. Available via <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Burundi%20First/CPDN%20BURUNDI.pdf>

Strategy/plan/programme	Year published	Priorities
		<ul style="list-style-type: none"> Reinforcement of climate change impact tracking systems by means of observations and investigations.
<p>4. Strategic plan: Burundi national development plan NDP Burundi 2018-2027.³⁶</p>	2018	<ul style="list-style-type: none"> Strengthening the economy of Burundi by enhancing national productivity. Strengthening the economy of Burundi by creation of new jobs.
<p>5. Strategic plan: Third national communication on climate change (TNCCC).³⁷</p>	2019	<ul style="list-style-type: none"> Capacity building in weather, climate and hydrological modelling and to cover all aspects of agro-meteorological assistance. Promote, encourage and support community adaptation strategies related to agriculture and livestock to cope with climate change. Integrate climate and environmental issues into water and resources sanitation improvement strategies/plans and develop risk assessments and measures for emergency situations.
<p>6. Strategic plan: National Strategy and Action Plan to Combat Soil Degradation 2011-2016.</p>	2011	<ul style="list-style-type: none"> Improved fertility of agricultural soils and ecological conditions in degraded areas. Institutional and community capacity building in soil management.
<p>7. Strategic plan: National Water Strategy 2011 – 2020.³⁸</p>	2012	<ul style="list-style-type: none"> Prevention and management of water-related disasters and protection of Water Resources. Instruments for the Integrated Management of Water Resources. Cooperation for the management of shared water resources with involvement of women and special consideration for vulnerable groups.
<p>8. Strategic plan: National Agriculture Strategy 2018-2027.³⁹</p>	2018	<ul style="list-style-type: none"> Rational and optimal exploitation of natural resources, in particular land and water resources. Development of resilience to climate change. Processing and preservation of food, pastoral and fishery products. Capacity building of institutional and organizational structures.
<p>9. Strategic plan: Technology Needs Assessment – Adaptation.⁴⁰</p>	2016	<p>Water Resources sector</p> <ul style="list-style-type: none"> Monitoring water quantities. Harnessing rainwater Control of the rain dynamics.

³⁶ <https://www.presidence.gov.bi/wp-content/uploads/2018/08/PND-Burundi-2018-2027-Version-Finale.pdf>

³⁷ <https://unfccc.int/sites/default/files/resource/Burundi%20TNC%20executive%20summary.pdf>

³⁸ https://www.pseau.org/outils/ouvrages/meeatu_strategie_nationale_de_l_eau_2011_2020_1970.pdf

³⁹ <http://extwprlegs1.fao.org/docs/pdf/Bur190783.pdf>

⁴⁰

https://unfccc.int/ttclear/misc/_StaticFiles/gnwoerk_static/TNA_key_doc/e2a748d4d7fb46a886411a2739cf72d7/eb976df133a34e74b758e3e22fd15490.pdf

<i>Strategy/plan/programme</i>	<i>Year published</i>	<i>Priorities</i>
		<p><i>Agriculture and Livestock sector</i></p> <ul style="list-style-type: none"> • Soil conservation systems. • Development of the short cycle rice variety • Community early warning systems
10. Strategic plan: Technology Action Plan – Adaptation. ⁴¹	2018	As per above

As per 2018, only one of the priority areas of the NAPA has been implemented (improve early warning climate forecasts). Others remain unfunded so far, leaving several vulnerable sectors without action on the identified priorities (including agriculture, freshwater and forestry). To successfully adapt to climate change, Burundi's NDC proposes to prioritize actions that reflect the priorities identified in its National Strategy and Action Plan on Climate Change (2012).

The next phases shall assess to what extent programme activities are aligned with the priorities in national and relevant sub-national key strategic documents, policy documents and plans related to climate change adaptation in the water sector. The next phases shall explore how to programme contributes to achieving the respective national adaptation priorities and corresponding national and international objectives.

During the next phases, the programme shall be streamlined with owners of Burundi's strategies, policies and plans to establish linkages between objectives, outcomes, and outputs. The extent to which this programme contributes to (inter)national objectives, such as the Sustainable Development Goals (SDGs), shall be embedded in the Theory of Change (ToC) and the corresponding M&E framework. The M&E team shall be responsible for keeping track of the realization of the project targets and therewith the contribution to Burundi's national and sub-national strategies, policies, and plans.

3.2 Environmental and Social Standards

This study conducts an initial screening of the ESP and the GP published by the Adaptation Fund (AF) who finances the programme. To ensure national ownership and sustainability of the outcomes, the programme shall be implemented in compliance with the (inter)national standards.

This study held consultations with various stakeholders to assess the environmental and social technical standards that can have an impact on the programme and its activities. The 15 principles in the ESP by the AF were screened against Burundi's national laws and standards. The table below depicts linkages between the 15 principles with national laws and the related standards following an initial screening done as part of this study.

⁴¹

https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNA_key_doc/faba3d9fb058453bb241a7c2b4d0c640/3239bd8f111e4c5b806077e759c98ad0.pdf

Table 7: Overview applicable social and environmental standards

Principle	National text enacting the standard	Standard
1. <i>Compliance with the Law</i>	Law No. 1/10 of June 30, 2000 on the Environmental Code of the Republic of Burundi. ⁴²	When developments, works or facilities risk harming the environment, the code obliges the petitioner or contracting authority to draw up and submit to the administration of the environment an impact study making it possible to assess the direct or indirect impacts of the project on the ecological balance, the environment and the quality of life of the population and the impacts on protection.
	Decree No. 100/22 of October 07, 2010 on measures for the application of the environmental code in relation to the environmental impact study procedure. ⁴³	This decree, in its articles 4 and 5, classifies projects into three categories: (i) projects that must be submitted to an environmental impact study regardless of the cost of their implementation, (ii) projects that are subject to an environmental impact study when the Ministry of the Environment considers that the characteristics, location or even the scale of the planned work are likely to affect the environment and (iii) projects which should not be subject to EIA
2. <i>Access and Equity</i>	Law No. 1/02 of March 26, 2012 on the Water Code in Burundi and its implementing texts. ⁴⁴	Avoid waste of water and in a watershed, the different uses of water are considered together and each use takes into account its effects on the others.
	Decree No. 100/189 of August 25, 2014 on the procedures for determining and installing the protection perimeters of water catchments intended for human consumption. ⁴⁵	The development of the perimeter is subject to the prior obtaining of competent authorisation, whatever the type of protection perimeter (article 3). Authorizations are issued by (i) the Minister in charge of water if the catchment is equipped with a water supply system and (ii) by the municipal administrator if the catchment does not include an adduction system, (articles 4 and 12). Any establishment of an immediate protection perimeter is preceded by the allocation of fair and prior compensation to owners and holders of other land rights on the non-state part of the perimeter in question, in accordance with the provisions of the land code in expropriation in the public interest (Article 10).
3. <i>Marginalized and Vulnerable Groups</i>	Article 22 of the Constitution of 18 March 2005. ⁴⁶	All citizens shall be equal before the law, which shall guarantee them equal protection. No-one may be discriminated against on the grounds of origin, race, ethnicity, gender, colour, language, social situation, religious, philosophical or political convictions or for being a carrier of HIV/AIDS or any other incurable illness.
4. <i>Human Rights</i>	Article 52 of the Constitution of 18 March 2005. ⁴⁷	Everyone is entitled to the enjoyment of the economic, social and cultural rights indispensable to their dignity and freedom of personal development, as a result of the national effort in this regard bearing in mind the country's resources".
5. <i>Gender Equality and Women's Empowerment</i>	National Gender Policy (NGP), 2012–2025, Ministère de la Solidarité Nationale, des Droits	The 2012–2025 NGP and accompanying action plan sets out to:

⁴² <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁴³ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁴⁴ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁴⁵ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁴⁶ https://tbinternet.ohchr.org/_layouts/15/treatybodyexternal/Download.aspx?symbolno=E/C.12/BDI/1&Lang=en

⁴⁷ https://tbinternet.ohchr.org/_layouts/15/treatybodyexternal/Download.aspx?symbolno=E/C.12/BDI/1&Lang=en

Principle	National text enacting the standard	Standard
	de la Personne Humaine et du Genre (2011)	<ul style="list-style-type: none"> Facilitate the creation of a sociocultural, legal, economic, political, and institutional environment conducive to the achievement of gender equality. Promote the mainstreaming of gender into development interventions in all areas. Strengthen equitable access of women, men, and adolescents to social services.
6. <i>Core Labour Rights</i>	Decree Law No. 1/037 of 07/07/1993 revising the labor code of the Republic of Burundi. ⁴⁸	Section 146 of Part 6 on occupational safety and health provides that “employers shall be required to comply with the provisions in force regarding the hygiene and safety of workers, the organisation and operation of corporate medical and health services, and special working conditions for pregnant women and young people”.
7. <i>Indigenous Peoples</i>	The Constitution of the Government of Burundi.	Burundi has no specific legislation addressing the situation of the Twa, and the main legal reference for their rights is the current Constitution, which was approved by popular referendum in 2005. The Constitution recognizes the ethnic diversity of Burundi and includes in several of its articles the principle of ethnic quotas and co-optations to reflect this diversity and ensure the participation of the three ethnic groups. At the same time it prohibits any form of exclusion based on ethnicity or regionalism. ⁴⁹
8. <i>Involuntary Resettlement</i>	The Land Code of the Republic of Burundi, Law No. 01/008 of 01/09/1986. ⁵⁰	The law provides the procedure for resettlement. Responsibility for resettlement lies with the Ministry of Water, Environment, Land and Urban Planning (MEEATU), but if land is in a wetland, the responsibility lies with the Ministry of Agriculture and Livestock.
	AFRICAN DEVELOPMENT BANK OP. 4.12 (INVOLUNTARY RESETTLEMENT). ⁵¹	Any development project should avoid or minimize involuntary resettlement and where this is not feasible, it should assist displaced persons in improving or at least resorting their livelihoods and living standards in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.
9. <i>Protection of Natural Habitats</i>	Law No. 1/10 of May 30, 2011 on the creation and management of protected areas in Burundi. ⁵²	Protected areas must be considered in the overall development plan and their management must go hand in hand with the development of the human environment along the river, and the participatory management of protected areas must be concerned improvement of the living environment of local communities (article 29).
	Law No. 1/02 of March 26, 2012 on the Water Code in Burundi and its implementing texts. ⁵³	The water code stipulates protected zones: 150 m wide on the shores of Lake Tanganyika, 25 m on each side of the lake's tributary rivers and 5 m for rivers not tributary to the lake. In the implementation of the

⁴⁸ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁴⁹ <https://www.ifad.org/documents/38714170/40224460/burundi.pdf/969773f0-9429-49d3-bccf-d02d4cbcdac4?t=1651742303327>

⁵⁰ <https://esa.afdb.org/sites/default/files/MULTINATIONAL%20BURUNDI-TANZANIE-RUMONGE-BUJUMBURA%20%20ROAD%20SECTION%20RAP%20%20%204th%20July%202018%20%282%29%20%281%29.pdf>

⁵¹ <https://esa.afdb.org/sites/default/files/MULTINATIONAL%20BURUNDI-TANZANIE-RUMONGE-BUJUMBURA%20%20ROAD%20SECTION%20RAP%20%20%204th%20July%202018%20%282%29%20%281%29.pdf>

⁵² <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵³ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

Principle	National text enacting the standard	Standard
		project, it will be necessary to avoid carrying out investments in these areas, except for irrigation works.
10. <i>Conservation of Biological Diversity</i>	Law No. 1/10 of June 30, 2000 on the Environmental Code of the Republic of Burundi (Titles III and IV). ⁵⁴	Works, structures and facilities to be carried out in the beds of watercourses will be designed and built in such a way as to maintain a minimum flow or volume of water guaranteeing the life, movement and reproduction of the species that inhabit the water at the time of carrying out these works, structures and developments (section 53).
	Law No. 1/28 of 24/12/2009 relating to the health policy of domestic, wild and aquaculture animals and bees. ⁵⁵	The law gives responsibility to three Ministries to protect animals. These are the Ministry of Agriculture and Livestock, the Ministry of Water, the Environment, Territorial Development and Urban Planning and the Ministry of Public Security.
11. <i>Climate Change</i>	The United Nations Framework Convention on Climate Change (UNFCCC). ⁵⁶	Take precautionary measures to prevent or mitigate the causes of climate change and limit their harmful effects (Article 3)
12. <i>Pollution Prevention and Resource Efficiency</i>	Law No. 1/02 of March 26, 2012 on the Water Code in Burundi and its implementing texts. ⁵⁷	Appropriate measures must be taken at all levels to ensure efficient management of resources and infrastructures, and to reduce the costs of water services.
13. <i>Public Health</i>	Decree 100/177 of July 9, 2013 on health inspection measures for animals and food products of animal origin. ⁵⁸	This decree lays down the health inspection and control measures for animals and products of animal origin, including live animals, meat, milk and dairy products (see chapter II, section 2, 3 and 5).
	Decree-Law No. 1/033 of June 30, 1993 on plant protection in Burundi. ⁵⁹	This law establishes the principles and rules governing phytosanitary protection in Burundi. Phytosanitary treatments must be carried out in compliance with good agricultural practices in order to preserve human and animal health and protect the environment.
14. <i>Physical and Cultural Heritage</i>	Law No. 1/6 of May 25, 1983 on the protection of the National Cultural Heritage. ⁶⁰	An asset classified as cultural heritage cannot be altered, degraded or destroyed; it is prohibited to use it for inscriptions, graffiti or displays. A classified property cannot be moved, notified, repaired, transformed or restored without the prior authorization of the Minister of Culture, taken on the assent of the Commission.
15. <i>Lands and Soil Conservation</i>	Law No. 1/10 of June 30, 2000 on the Environmental Code of the Republic of Burundi (Titles III and IV). ⁶¹	The preservation of soil against erosion is a national and individual ecological duty, and the measures to be taken to achieve this objective may be declared of public utility and be binding on any operator or occupant land (article 29).

The programme organisation shall include members/representatives with the right capabilities to ensure compliance with standards such as Environmental Impact

⁵⁴ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁵ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁶ https://www.obpe.bi/images/pdf/strategic_framework_environment_management.pdf

⁵⁷ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁸ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁵⁹ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

⁶⁰ http://www.african-archaeology.net/heritage_laws/burundi1983.html

⁶¹ <https://www.obpe.bi/images/pdf/cadreGestion.pdf>

Assessments (EIAs). As part of the feasibility study, programme activities shall be screened, and their impacts shall be assessed and linked with the standards for all 15 principles. Depending on the magnitude of the impacts, screened activities will undergo an EIA or review in accordance with EIA procedures and guidelines. Appropriate responses will be formulated and discussed following the outcome of the EIAs.

Following the initial screening, this study classifies the programme as a “**Category C**” programme meaning that, according to the ESP by the AF, that it has no adverse environmental or social impacts. The reasoning behind this categorization is that the aim of the programme is to improve environmental and social impacts using inputs from especially vulnerable groups in target communities. Implementation of adaptation tools and technologies shall consider possible adverse impacts before and during the implementation. The programme shall redesign the adaptation tools and technologies to prevent adverse impacts in case the feasibility study indicates that there are adverse impacts.

3.3 Linkages with Programmes / Projects in Burundi

This study assessed completed, ongoing, and planned initiatives in Burundi related to flood and drought risk management. The next phases will explore any duplications and ensure alignment with ongoing and planned initiatives. Various sources containing programmes in Burundi have been studied including (i) the World Bank, (ii) The AF, (iii) the GEF (Global Environment Facility), (iv) the GCF (Green Climate Fund), (v) the GCA (Global Center of Adaptation) and (vi) the AfDB (African Development Bank). It is imperative to conduct gap analyses at a later stage to ensure there is no duplication with other programs / funding sources. Any unforeseen duplications will come to light when conducting gap analyses during multi-stakeholder workshops.

The table below summarizes the scope of the main planned and ongoing initiatives in the water sector including the objectives and scope of these projects and programmes.

Table 8: Overview related projects and programmes

Project/programme	Objective(s)	Scope
<p>1. Programme: Climate proofing food production investments in Imbo and Moso basins in the Republic of Burundi.⁶²</p> <p><i>Approved 2020</i></p>	<p>Transforming current agro-ecological land and water management practices in the upper, middle, and lower Imbo and Moso catchments towards more sustainable and productive land use practices.</p> <p>Build farmers' resilience to climate change in the upper, middle, and lower Imbo and Moso catchments and to increase agricultural productivity and food security through adoption of better agroecosystem management practices to</p>	<p>Region Imbo and Moso basins</p> <p>Deliverables</p> <ul style="list-style-type: none"> • Design and implement landscape management plans with farmers for soil and water practices. • Supporting capacity building and implementation of water harvesting structures. • Supporting improved post-harvesting activities. • Training of farmers in soil and water conservation practices.

⁶² <https://www.greenclimate.fund/sites/default/files/document/sap017-ifad-burundi.pdf>

Project/programme	Objective(s)	Scope
	conserve soil and water resources.	
<p>2. Programme: Community Disaster Risk Management in Burundi (<i>Bugesera, Mumirwa and Imbo Lowlands regions</i>)⁶³</p> <p><i>Approved 2014</i></p>	<p>Early warning systems (on climate change induced risks including new or emerging vulnerabilities and hazards) established for communities.</p> <p>Livelihoods and infrastructure risk assessment undertaken with gender-focused analysis.</p> <p>Policy actions undertaken on the basis of anticipated climate change projections.</p> <p>Flood Control in Bujumbura.</p>	<p>Region Bugesera, Mumirwa and Imbo Lowlands.</p> <p>Deliverables</p> <ul style="list-style-type: none"> Community Based Early Warning System on climate change related risks in Bujumbura Rural, Kirundo and Makamba Provinces. Hydrometeorological network and improving capacity to generate real-time information weather and data series for information dissemination to target communities. Effective and efficient communication and dissemination system to reach all end users. Gender and climate vulnerability assessment to guide the development of a local climate change response. Stabilization works undertaken in Ntakangwa and Gaseyni Rivers to reduce the risk of flooding landslides in Bujumbura City.
<p>3. Programme: Restructuring of the Value Chain Development Programme (PRODEFI)⁶⁴</p> <p><i>Approved 2015</i></p>	<p>Contribute to increasing incomes and improving the food security and nutrition of poor households in a sustainable manner in areas of intervention by strengthening priority agricultural sectors (rice and milk). In addition, enhance the resilience of production systems and the facilitation of a sustainable partnership with public, private and civil society institutions.</p>	<p>Region Bubanza, Cibitoke, Gitega, Karusi, Kayanza, Muramvya and Ngozi Province.</p> <p>Deliverables</p> <ul style="list-style-type: none"> Irrigation schemes and infrastructure. Design of rural engineering structures to climate variability. Intensification of agricultural production. Support to priority sectors
<p>4. Programme: Burundi Landscape Restoration Project⁶⁵</p> <p><i>Approved 2016</i></p>	<p>Restore degraded landscapes by community members in two priority regions, and in the event of an eligible crisis or emergency, to provide immediate and effective response to said eligible crisis or emergency.</p>	<p>Region (North-West region) Bubanza, Kayanza, Bujumbura Rural, (East region) Cankuzo, Ruyigi and Muyinga Province</p> <p>Deliverables</p> <ul style="list-style-type: none"> Strengthened role of traditional and local institutions in landscape restoration. Enhanced access to improved climate information and early-warning systems. Investments in restoration of degraded lands and support ecosystem-based adaptation.

⁶³ <https://www.thegef.org/projects-operations/projects/4990>

⁶⁴ <https://www.ifad.org/documents/38711624/40089492/PRODEFI+II+Rapport+de+conception+detaile.pdf/6b0c1812-9550-4763-9d46-a26dc6ce7b73?t=1611227252000>

⁶⁵ <https://documents1.worldbank.org/curated/en/408471487004538339/pdf/ITM00184-P160613-02-13-2017-1487004534488.pdf>

Project/programme	Objective(s)	Scope
<p>5. Programme: Natural Landscapes Rehabilitation and Climate Change Adaptation in the Region of Mumirwa in Bujumbura and Mayor of Bujumbura through a Farmer Field School Approach⁶⁶</p> <p><i>Approved 2019</i></p>	<p>Address the root causes of landscape degradation due to climate change and unsustainable land uses by rehabilitating degraded land and adapting integrated farming and natural systems to climate change in the.</p>	<p>Region Region of Mumirwa in Bujumbura Mairie and in the Lake Tanganyika coastal area.</p> <p>Deliverables</p> <ul style="list-style-type: none"> • Training to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures. • Risk and vulnerability assessments and relevant technical assessments carried out and updated. • Institutional arrangements to lead, coordinate and support the integration of climate change adaptation (CCA) into relevant policies, plans and associated processes. • Type and extent of assets strengthened and/or better managed to withstand the effects of climate change. • Number of people/ geographical area with access to improved climate information services.
<p>6. Programme: Consultancy to support delivering climate resilient and sustainable water services to rural communities in Burundi.⁶⁷</p> <p><i>Planned for 2023</i></p>	<p>Provide technical assistance: (a) to undertake a climate risk assessment in five provinces in Burundi with a focus on water resources, and water service delivery assets; and, (b) to provide technical inputs into the design of measures for climate-resilient catchment management and into the mitigation of climate risk to water service delivery assets.</p>	<p>Region</p> <ul style="list-style-type: none"> • Five (undisclosed) provinces. <p>Deliverables</p> <ul style="list-style-type: none"> • A rapid risk assessment – desk-based using available data - to identify climate change hotspots in the five select provinces in Burundi. • In-depth assessment of risks stemming from climate change for the identified hotspot catchments. • Identify suitable adaptation measures for catchments and provide technical assistance to design measures that combine grey, green and social investments.
<p>7. Programme: Community Disaster Risk Management in Burundi.⁶⁸</p> <p><i>Approved 2014</i></p>	<p>Improve local communities' capacities on climate disaster risks preparedness and responses management to ensure long term and sustainable emergency and reconstruction phase in Bugesera, Mumirwa and Imbo Lowlands' regions.</p>	<p>Region</p> <ul style="list-style-type: none"> • Kirundo, Bujumbura Rural, Bururi and Makamba. <p>Deliverables</p> <ul style="list-style-type: none"> • An operational Community Based Early Warning system established capable to engage and reach out target communities for climate change disasters risks prevention and guiding the implementation of adaptation activities. • Communal services, relevant ministry support services and Provincial disaster risks platforms trained to use climate risks management tools for

⁶⁶ <https://www.thegef.org/projects-operations/projects/8010>

⁶⁷ https://gca.org/wp-content/uploads/2022/08/GCA-PR-22-184-REOI-Climate-Resilient-and-Sustainable-Water-Services-in-Burundi_Final95.pdf

⁶⁸ <https://www.thegef.org/projects-operations/projects/4990>

<i>Project/programme</i>	<i>Objective(s)</i>	<i>Scope</i>
		<p>long term planning under climate change variability and projections.</p> <ul style="list-style-type: none"> Investment on relevant early warning systems and adaptation technologies to protect infrastructures and local livelihoods from climate impacts.
<p>8. Programme: Great Lakes Regional Integrated Agriculture Development Project.⁶⁹ <i>Approved 2017</i></p>	<p>To increase agricultural productivity and commercialization in targeted areas in the territory of the recipient and improve agricultural regional integration.</p> <p>To provide immediate and effective response in the event of an eligible crisis or emergency.</p>	<p>Region</p> <ul style="list-style-type: none"> Ruzizi Plain and the Imbo region, and the geographic corridor along Lake Tanganyika <p>Deliverables</p> <ul style="list-style-type: none"> Facilitate farmers' access to improved production packages (e.g. seed). Promote the adoption of climate smart agriculture. Rehabilitate irrigation infrastructure and Strengthen capacity of water user associations to manage irrigation systems and improve watershed management. Strengthening of selected Business Development Services (BDS) (to support value chains). Exchanges of information, knowledge, and technologies through channels such as a web-based exchange platform.

Overall, the conclusion is that there are planned, ongoing and completed programmes in Burundi to enhance resilience to climate change in the water sector, albeit a limited number of programmes compared to other (developing) countries. Some of these programmes harbor the risk of duplication, especially with regards to (i) flood and drought early warning, (ii) capacity building and (iii) strategic plan and policy development. Further analysis is required to what extent the possible duplication impacts this programme, the results of which shall be included in the design of the programme.

3.4 Roles and responsibilities for flood and drought risk management

This study assessed the different roles, responsibilities, and arrangements between institutions in the field of flood and drought risk management. Roles and responsibilities for flood and drought risk management and institutional arrangements are identified. Several stakeholders of institutions at various governance levels are likely to be involved in the decisions relating to implementation of the flood and drought adaptation measures. The table below reflects which institution is responsible in which stage of the decision-making process, and it shows that a variety of actors and institutions whose responsibilities sometimes overlap would need to be consulted. This complexity might give rise to challenges in the implementation and management of the adaptation interventions. Another difficulty lies in the fact that there is a tendency in current plans to favor conventional flood and drought resilient measures. The feasibility study will elaborate on the roles and responsibilities to clarify these on a more granular level.

⁶⁹ <https://projects.worldbank.org/en/projects-operations/document-detail/P161781?type=projects>

Table 9: Roles and responsibilities regarding policy decision

	Policy making		Policy Implementation		Investment	Operational management	Regulation and enforcement		
	Priority setting	Strategic planning	Data & info management	Capacity development	Investment planning	Service delivery	Monitoring & supervision	Controlling & auditing	Conflict management
Government Office	✓	✓					✓	✓	✓
Parliamentary office	✓							✓	
All Ministries	✓	✓							
Supervising ministry			✓	✓	✓	✓	✓	✓	✓
Other departments		✓	✓						
Workgroups			✓	✓		✓			
NGOs			✓	✓	✓	✓			
External experts			✓	✓	✓	✓		✓	

3.5 Stakeholders and potential beneficiaries

A stakeholder mapping was developed as part of this study. The purpose of the stakeholder mapping is to ensure the interests of different stakeholder groups, especially vulnerable groups such as women and youth, are incorporated in the design of the programme. Ultimately, all stakeholders should work towards a shared objective.

The consultation process started off with the identification of the different stakeholder groups whose support is needed or those who have another vested interest in this programme. The identification of these stakeholder groups was done in collaboration with a representative of the Ministry of Environment, Agriculture and Livestock of Burundi who is the focal point of the AF.

The consultation process was carried out by organizing online and onsite meetings with local authorities, field visits and workshops with community members. Events such as meetings and workshops aimed to have representatives of as many stakeholder groups as possible. The discussions also focused on identifying and validating the threats/problems and needs of the selected territories. This enabled a consensus on the objectives, results, and measures to respond to problems. The consultation workshops and meetings aimed to:

- Provide information on the proposal development processes.
- Inform partners and beneficiary populations about the project scope and objectives.
- Listen to participants' expectations and needs and take them into consideration in the design of the programme.
- Verify information collected from stakeholders and literature through triangulation.

The consultation process was conducted at national and sub-national level. Consultations at national level centered around programme execution as well as impact on and alignment with (inter)national plans, policies, and corresponding objectives. The consultations focused on how to govern with regards to climate adaptation tools, technologies, and practices and how to align activities at different levels. Consultations at local level were with the ultimate beneficiaries and centered around the impact of flood and drought events on the selected sites and how the new adaptation interventions can enhance resilience.

Preliminary discussions were held with officials working in the areas of hydrology, meteorology, and disaster management to understand the climate context and supporting policy environment as well as most pressing adaptation needs with regards to flood and drought. In addition, discussions were held with officials involved in sponsored climate programmes to get a view of initiatives in the country that ought to be aligned with this programme. The key takeaways from the consultations are:

- Participants understand what the proposal development processes.
- Participants understand the project objectives and scope.
- There is a broad consensus on the flood and drought risks and the adaptation needs.
- Participants provided substantive and valuable feedback.

During the next phases, a feedback mechanism shall be developed to allow for stakeholders' views to be heard during project implementation. Feedback will be considered during the design and implementation of the programme.

The community-driven programme requires the involvement of various stakeholder groups to garner their perspectives on innovation. A co-design process ensures inclusive participation and continuous engagement of all partners, including buy-in and commitment. These partnerships help generate new solutions and scale those solutions to make progress. Involving all partners in co-designing the goals and scope of a given partnership is a critical step in ensuring its success and ability to create meaningful impact.

The co-design process takes place during the next phases and is an adaptation of the “P.ACT: Partnership Co-Design Toolkit”⁷⁰. The co-design process and the establishment of partnerships follows four stages:

- i. Learn stage: Explore and clarify partners' respective motivations, capabilities and cultures.
- ii. Imagine stage: Converge on the partnership value proposition, impact, and type of partnership.
- iii. Create stage: Define the partnership activities, roles, and governance structure.
- iv. Evaluate stage. Establish the distribution of value and costs and to define the partnership's monitoring metrics.

This study has listed the individuals and organizations that form a partnership. These stakeholders in a partnership are categorized as: (i) Customers, (ii) Community, (iii) Partners and (iv) Institutions. The table below provides an initial overview of the key stakeholders that are part of each partnership in this programme.

Table 10: Overview consultations and number of participants

Key stakeholder	Partnership 1	Partnership 2	Partnership 3	Partnership 4
(i) Customers				
1. Produce export traders	✓			✓
2. Smallholder farmers	✓	✓	✓	✓
3. Pastoralists	✓	✓	✓	
4. Representatives of agricultural cooperatives		✓	✓	✓
(ii) Community				
5. Farmer families (community)	✓	✓	✓	✓
6. Women's association	✓	✓	✓	✓
7. Indigenous peoples	✓	✓	✓	✓
8. Civil society	✓	✓	✓	✓
(iii) Partners				
9. Environmental expertise/field	✓			
10. Agricultural industries			✓	✓
11. Extension agents (e.g. training institutes)			✓	✓
(iv) Institutions				
12. Disaster preparedness and management	✓	✓		
13. Hydrology department	✓			
14. Environmental protection department		✓		
15. Agriculture and Livestock Research Institution		✓	✓	✓

⁷⁰ <https://d-lab.mit.edu/resources/publications/pact-partnership-co-design-toolkit>

Key stakeholder	Partnership 1	Partnership 2	Partnership 3	Partnership 4
16. Provincial Technical Services (Agriculture and Livestock)	✓	✓	✓	✓
17. Territorial administration		✓		
18. Local government	✓	✓		
19. Regional/provincial government	✓	✓		
20. Grant funder	✓			✓
21. Financial institutions (incl. insurer)	✓	✓		
22. Embassy of the Netherlands in Burundi		✓		
23. University of Burundi		✓	✓	
24. University in the Netherlands		✓	✓	

Definitions:

- *Customers: Individuals or entities who buy or pay for your products/services*
- *Community: Local community members benefiting from the partnership*
- *Partners: Individuals or entities working with the partners*
- *Institutions: Institutions providing an enabling environment for the partnership*

During the next phases the programme organisation shall draw on multiple perspectives on innovation from key stakeholders who will form a partnership.

4. Proposed flood and drought resilient interventions

This section will focus on describing the combination of interventions in selected sub catchments in the Imbo Basin. As mentioned, the main objective of this study is to conduct a preliminary assessment of the feasibility of the portfolio of interventions and their ability to deliver flood and drought risk reduction services in the Imbo river basin.

The adaptation measures and implementation locations have been designed and selected following a participatory approach whereby input of local stakeholders (NGO, farmers, community, hydrologist, government) has been collected in addition to input by foreign experts who were also involved in the pilot project in Burundi. Secondary information was collected to substantiate input provided by local and foreign experts. The data that were used to design interventions and select implementation locations include:

- Flood hazard maps
- Land use maps
- Population density maps
- Damage curves
- Digital elevation maps
- Scientific literature
- Online sources on flood and drought risks in Burundi

The feasibility study shall include a workgroup with the University of Delft, University of Burundi and possibly knowledge institutions such as Deltares. These institutions shall co-design and evaluate / test the designed portfolio of adaptation measures. The designed blueprint of the combination of adaptation measures shall be tested during the programme execution. A successful outcome of this test enables scale-up of these measures across Burundi and other (developing) countries.

4.1 Overview of proposed interventions per sub-basin

Four of the provinces in Burundi within the Imbo Basin are: (i) Cibitoke, (ii) Bubanza, (iii) Bujumbura Rural and (iv) Bujumbura Mairie. Each province has various regions/districts that are impacted by flood and drought. This study has reviewed which of the sub-basins within the Imbo Basin across the four provinces should be the focus of further analyses. The table below provides insight in which sub-basins have the highest risk of the flood and drought.

Table 11: Characteristics of sub-basins in Imbo Basin

Sub-basins	Area (km ²)	Population	Risk level		
			Riverine Flood	Urban Flood	Water Scarcity
1. Cibitoke Province					
F1. Rugombo	204	120,344	High	Low	Medium
F2. Buganda	170	95,778	High	Very Low	Very Low
D1. Mugina	277	119,943	Very Low	Very Low	Medium
D2. Mabayi	334	85,643	Very Low	Very Low	Medium
D3. Bukinanyana	324	96,973	Very Low	Very Low	Medium
1. Bubanza Province					
F3. Gihanga	269	80,115	High	Low	Very Low
D4. Mpanda	125	100,027	Low	Very Low	Very Low
1. Bujumbura Rural Province					
F4. Mutimbuzi	288	96,050	High	Medium	Very Low
F5. Kabezi	228	67,750	High	Very Low	Very Low
1. Bujumbura Mairie Province					
F6. Entire province	113	862,693	Low	Low	Very Low

Legend risk levels⁷¹:

- High = high impact flood or drought event is likely to occur at least once in 10 years
- Medium = 20% chance that high impact flood or drought event occurs once in coming 10 years
- Low = 1% chance that high impact flood or drought event occurs in coming 10 years
- Very Low = less than 1% chance that high impact flood or drought event occurs in coming 10 years

This study explores a possible implementation of the adaptation measures at each sub-basin where the risk of riverine flooding is considered “High” being: (i) Rugombo, (ii) Buganda, (iii) Gihanga, (iv) Mutimbuzi and (v) Kabezi. In addition, this study also describes the envisioned interventions for (vi) the Mpanda region seeing as this sub-basin was also partly in scope of the pilot project. The four remaining sub-basins that have a lower risk of flooding and can be studied in the next phases. The six sub-basins of this study are depicted in Figure 20.

⁷¹ <https://thinkhazard.org/en/report/43-burundi/FL>

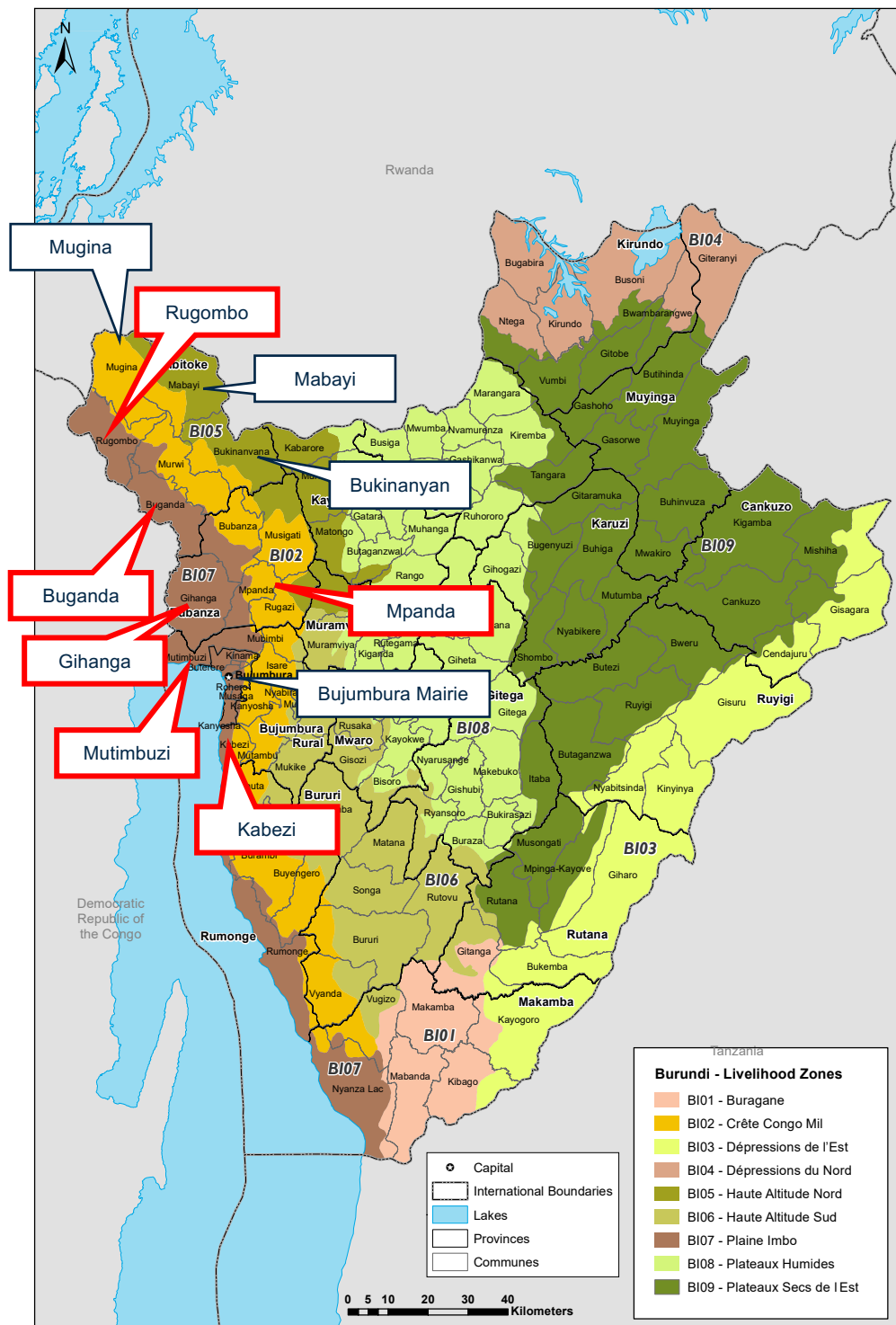


Figure 20: Livelihood zones⁷² (red colored zones are included in this study)

Hydrodynamic modelling software is applied for this study using global datasets that are readily available. These tools give an initial idea of the catchment area and where the different adaptation measures could be implemented. This study has narrowed down the scope to six sub-basins in the Imbo Basin reflected in below figure.

⁷² https://fews.net/sites/default/files/documents/reports/BI_zonedescriptions_20210419_en.pdf

land use maps, (iii) damage curves and (iv) population density maps. To increase the level of accuracy and reliability of the measured adaptation benefits, it is imperative to utilize local specific data such as Light Detection and Ranging (LiDAR) data. The adaptation measures realise additional benefits that are not measured with the FIS tool such as drought damages reduction; other benefits will be measured in the next phases.

A qualitative evaluation of the benefits per adaptation measure is given per sub-basin, following the scale given in Table 12 below.

Table 12: Anticipated impact each adaptation measure

Legend	Low	Medium	High
Expected magnitude of benefits created by combination of interventions	+/-	+	++

Legend risk levels:

- *High = Intervention has a high number of benefits for a specific area*
- *Medium = Intervention has a moderate number of benefits for a specific area*
- *Low = Intervention has a low number of benefits for a specific area*

4.1.1 Rugombo region

The main objective is to mitigate flood risk and harness flood- and rainwater for irrigation purposes in the Rugombo sub-basin; its river network is depicted in Figure 22.



Figure 22: River network in the Rugombo sub-basin

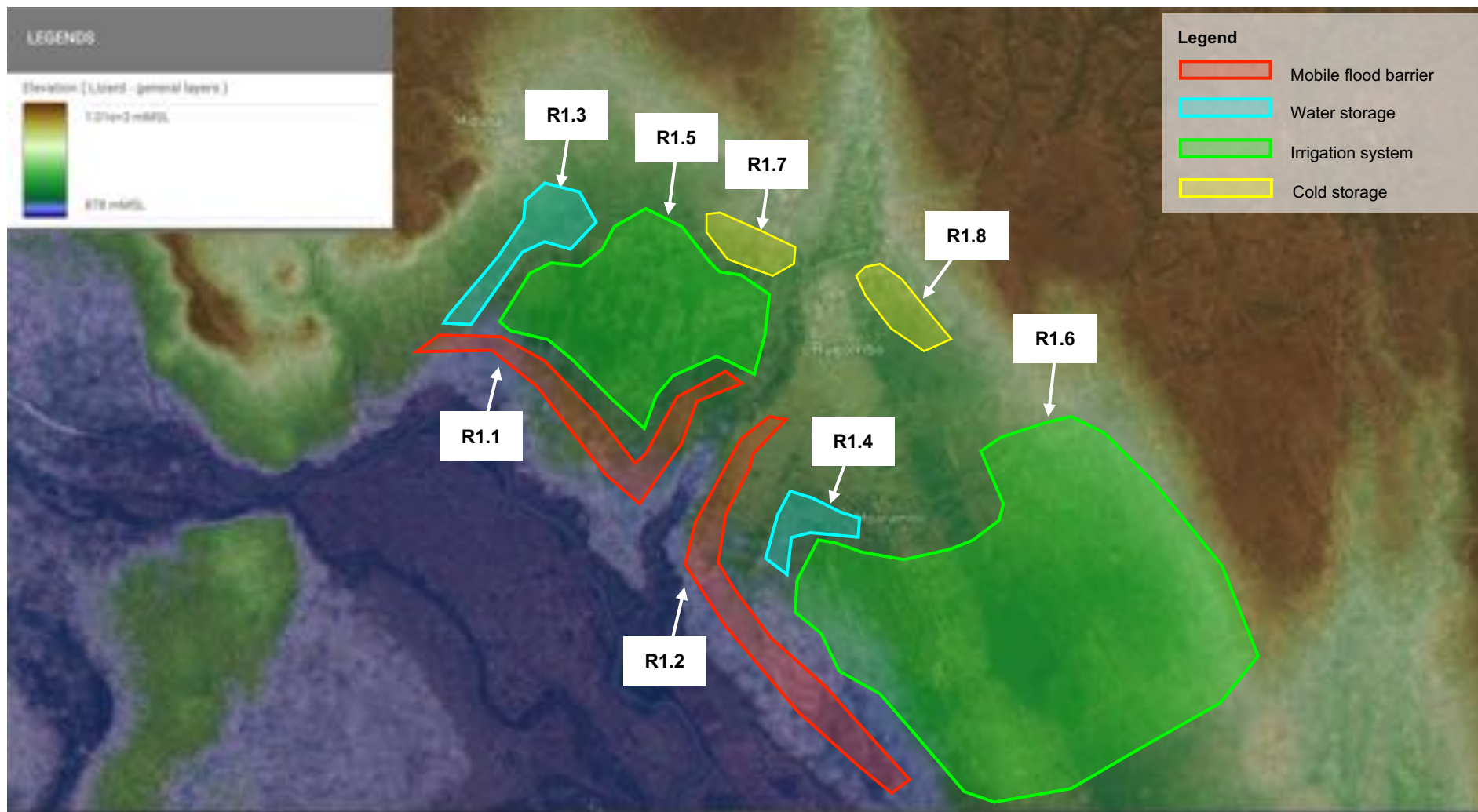


Figure 23: Potential locations in the Rugombo sub-basin to implement measures

Proposed interventions

This study assessed where the different adaptation measures could be implemented in the Rugombo sub-basin as shown in Figure 23. These locations have been selected using hydrodynamic modeling software. Table 13 below provides a description of the different adaptation measures at the proposed locations.

Table 13: Proposed interventions in Rugombo

Intervention	Description
R1.1 – R1.2 Water-filled mobile flood barrier	There is a high risk of riverine flooding near the Rugombo Commune during flood season when water levels of the Nyakagunda River rise; this is a branch of the Ruzizi River. The proposed positions of the mobile flood barrier ensure that agricultural land and settlements in Rugombo are protected from flooding.
R1.3 – R1.4 Water harvesting infrastructure	Two locations have been identified where flood- and rainwater are harnessed (upstream) using the mobile flood barrier to redirect waterflows. Water is stored the mobile flood barrier and in engineered lakes to use it for irrigation or drinking water purposes in times of drought. The mobile flood barrier directs water to the lakes. A technology is applied to ensure water stored in the mobile flood barrier and the lakes doesn't evaporate.
R1.5 – R1.6 Pumping and irrigation system	The harnessed water is pumped out of the mobile flood barrier and the engineered lakes and flows downstream through an irrigation system. This process ensures that two large areas of agricultural land can be used for crops production even during dry season. The water can also be used as drinking water for livestock.
R1.7 – R1.8 Solar-powered cold storage	Crops and livestock products are stored in a solar-powered cold storage unit. Cold storage enhances the lifespan of food products therewith improving food security and the economy. Solar technology ensures the usage of clean energy to preserve food products.
Information technology	Abovementioned adaptation measures are supported by information technology solutions including (i) hydrodynamic modeling software, (ii) FIS, (iii) the Optimal Dam Locator and (iv) EWSs.
Adaptation practices	Local stakeholders shall undergo capacity building workshops and trainings to mitigate flood and drought risks using the implemented adaptation measures.

A qualitative evaluation of the benefits per adaptation measure at the proposed locations is depicted in Table 14 below.

Table 14: Impact adaptation measures in the Rugombo sub-basin

	R1.1 – R1.2	R1.3 – R1.4	R1.5 – R1.6	R1.7 – R1.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
Assets and people made more resilient to flood and drought	++	++	+	+/-	++	+
Livelihoods and sources of income strengthened	+	++	++	++	+	+

	R1.1 – R1.2	R1.3 – R1.4	R1.5 – R1.6	R1.7 – R1.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
The number of people who are warned in advance increased	+	+/-	+/-	+/-	++	++
Vulnerable natural ecosystems strengthened	++	+	+/-	+/-	+	++
Active, skilled and materialised local response team	++	+	+/-	+/-	++	++
People trained regarding climate change and adaptation	++	+	+/-	+/-	++	++

Expected impact of the benefits on interventions:

- ++ = High impact on benefits anticipated
- + = Medium impact on benefits anticipated
- +/- = Low impact on benefits anticipated

4.1.2 Buganda region

The main objective is to mitigate flood risk and harness flood- and rainwater for irrigation purposes in the Buganda sub-basin; its river network is depicted in Figure 24.

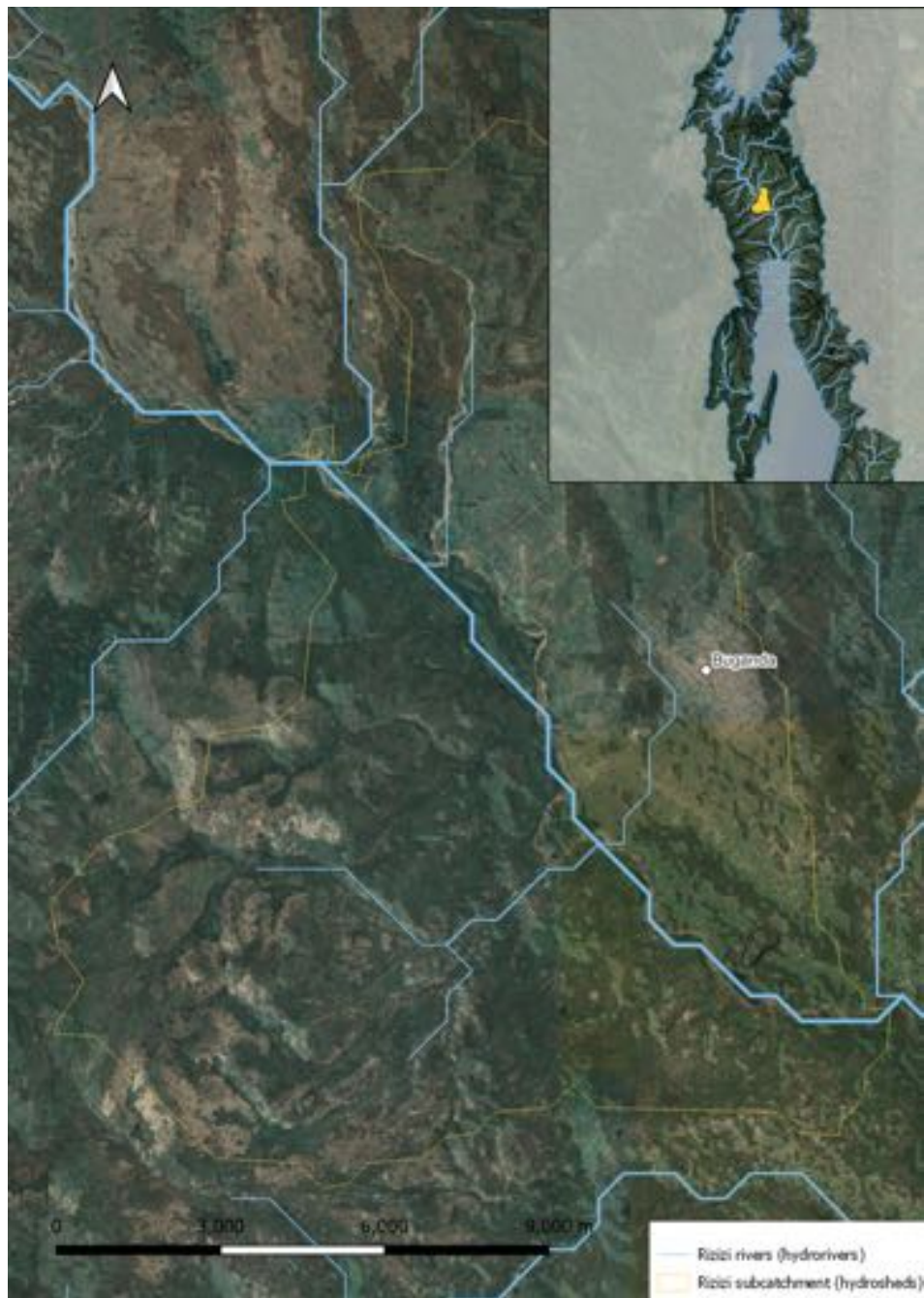


Figure 24: River network in the Buganda sub-basin

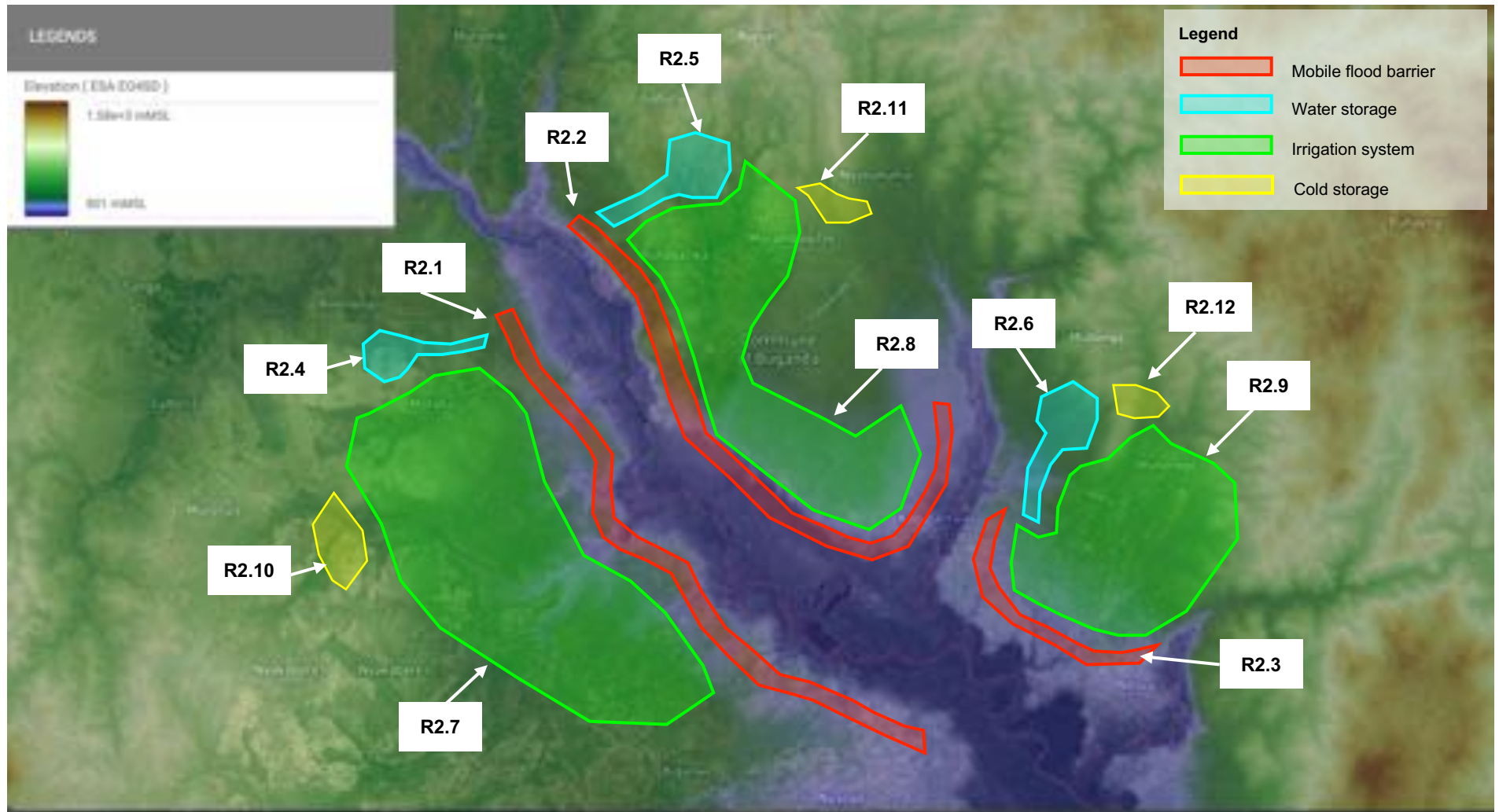


Figure 25: Potential locations in the Buganda sub-basin to implement measures

Proposed interventions

This study assessed where the different adaptation measures could be implemented in the Buganda sub-basin as shown in Figure 25. These locations have been selected using hydrodynamic modeling software. Table 15 below provides a description of the different adaptation measures at the proposed locations.

Table 15: Proposed interventions in Buganda

Intervention	Description
R2.1 – R2.3 Water-filled mobile flood barrier	There is a high risk of riverine flooding during flood season when water levels of the Ruzizi River rise. Three locations on both sides of the river are proposed where the mobile flood barrier could be deployed to ensure that the agricultural land and the settlements in Buganda are protected from flooding.
R2.4 – R1.6 Water harvesting infrastructure	Flood- and rainwater are harnessed upstream using the mobile flood barrier to redirect waterflows of the Ruzizi River. Water is stored in the mobile flood barrier and in engineered lakes to use it for irrigation or drinking water purposes in times of drought. Three locations for the lakes are proposed, one for each consequent deployed mobile flood barrier.
R2.7 – R2.9 Pumping and irrigation system	The harnessed water is pumped out from the lakes and flows downstream through an irrigation system. This process ensures that large areas of agricultural land can be used for crops production even during dry season. Each of the lakes comes with a pumping and irrigation system.
R2.10 – R2.12 Solar-powered cold storage	Crops and livestock products are stored in a solar-powered cold storage unit. Cold storage enhances the lifespan of food products therewith improving food security and the economy.
Information technology	Abovementioned adaptation measures are supported by information technology solutions including (i) hydrodynamic modeling software, (ii) FIS, (iii) the Optimal Dam Locator and (iv) EWSs.
Adaptation practices	Local stakeholders shall undergo capacity building workshops and trainings to mitigate flood and drought risks using the implemented adaptation measures.

A qualitative evaluation of the benefits per adaptation measure at the proposed locations is depicted in Table 16 below.

Table 16: Anticipated impact interventions in the Buganda sub-basin

Benefit Area	R2.1 – R2.3	R2.4– R2.6	R2.7 – R2.9	R2.10 – R2.12	Inform. techno.	New practices
	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage		
Assets and people made more resilient to flood and drought	++	++	+	+/-	++	+
Livelihoods and sources of income strengthened	+	++	++	++	+	+

	R2.1 – R2.3	R2.4– R2.6	R2.7 – R2.9	R2.10 – R2.12		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
The number of people who are warned in advance increased	+	+/-	+/-	+/-	++	++
Vulnerable natural ecosystems strengthened	++	+	+/-	+/-	+	++
Active, skilled and materialised local response team	++	+	+/-	+/-	++	++
People trained regarding climate change and adaptation	++	+	+/-	+/-	++	++

Expected impact of the benefits on interventions:

- **++** = High impact on benefits anticipated
- **+** = Medium impact on benefits anticipated
- **+/-** = Low impact on benefits anticipated

4.1.3 Gihanga region

The main objective is to mitigate flood risk and harness flood- and rainwater for irrigation purposes in the Gihanga sub-basin; its river network is depicted in Figure 26.



Figure 26: River network in the Gihanga sub-basin

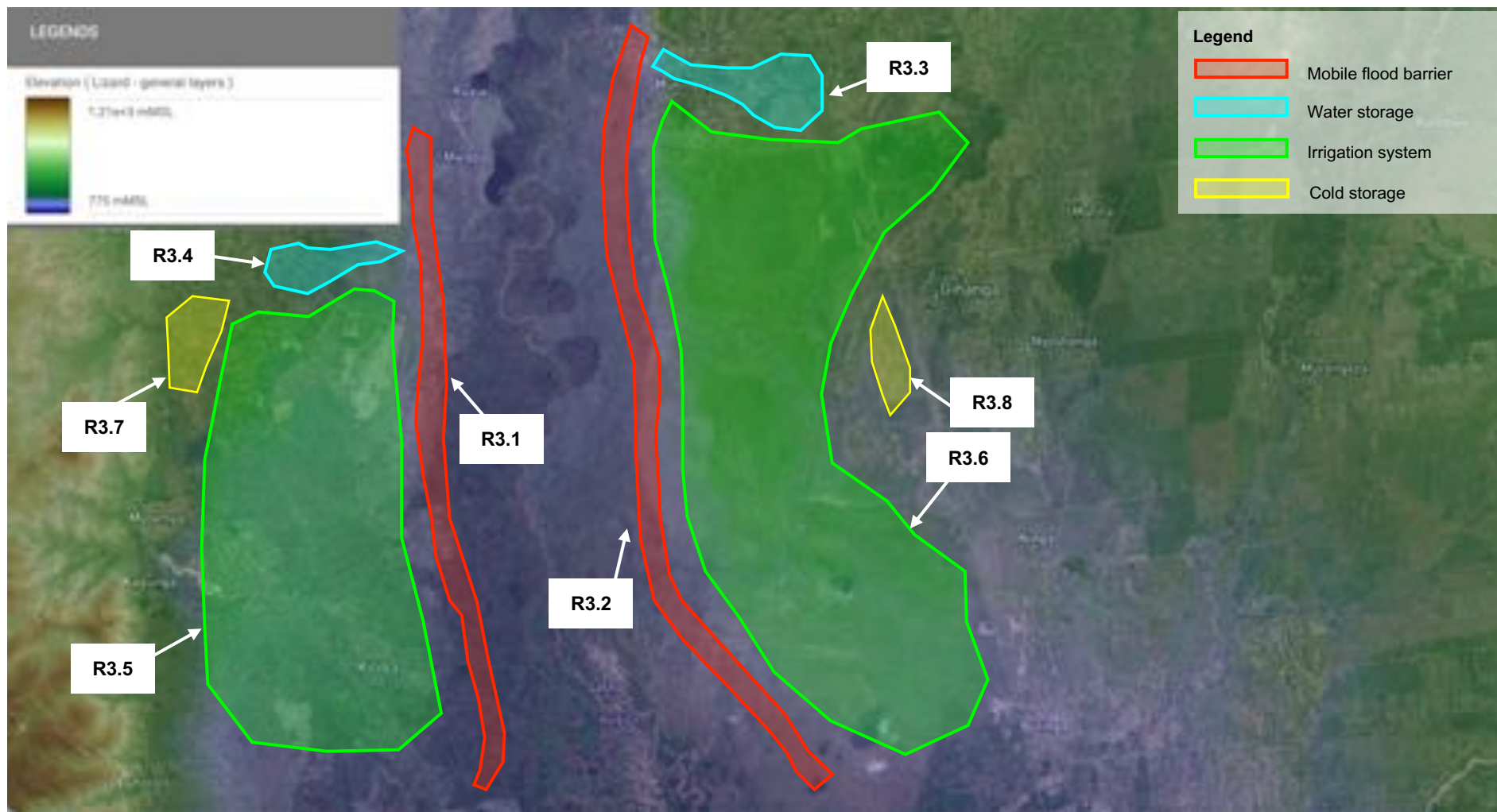


Figure 27: Potential locations in the Gihanga sub-basin to implement measures

Proposed interventions

This study assessed where the different adaptation measures could be implemented in the Gihanga sub-basin as shown in Figure 27. These locations have been selected using hydrodynamic modeling software. Table 17 below provides a description of the different adaptation measures at the proposed locations.

Table 17: Proposed interventions in Gihanga

Intervention	Description
R3.1 – R3.2 Water-filled mobile flood barrier	There is a high risk of riverine flooding in Gihanga during flood season when water levels of the Ruzizi River rise. The two proposed locations of the mobile flood barrier on each side of the river ensure that the agricultural land and the settlements in Gihanga are protected from flooding. The mobile flood barrier creates a corridor on each side of the river to redirect water of the Ruzizi River.
R3.3 – R3.4 Water harvesting infrastructure	Flood- and rainwater are harnessed upstream using the mobile flood barrier to redirect waterflows. Water is stored in engineered lakes to use it for irrigation or drinking water purposes in times of drought. These water retention lakes are engineered upstream on each side of the river.
R3.5 – R3.6 Pumping and irrigation system	The harnessed water is pumped out and flows downstream through an irrigation system. This process ensures that large areas of agricultural land can be used for crops production on each side of the river, even during dry season. A solar pump and gravity ensure clean energy is used to move the flow of water.
R3.7 – R3.8 Solar-powered cold storage	Crops and livestock products are stored in a solar-powered cold storage unit. Cold storage enhances the lifespan of food products therewith improving food security and the economy. Solar panels ensure that clean energy is used to preserve the food products.
Information technology	Abovementioned adaptation measures are supported by information technology solutions including (i) hydrodynamic modeling software, (ii) FIS, (iii) the Optimal Dam Locator and (iv) EWSs.
Adaptation practices	Local stakeholders shall undergo capacity building workshops and trainings to mitigate flood and drought risks using the implemented adaptation measures.

A qualitative evaluation of the benefits per adaptation measure at the proposed locations is depicted in Table 18 below.

Table 18: Anticipated impact interventions in the Gihanga sub-basin

	R3.1 – R3.2	R3.3 – R3.4	R3.5 – R3.6	R3.7 – R3.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
Assets and people made more resilient to flood and drought	++	++	+	+/-	++	++
Livelihoods and sources of income strengthened	+	++	++	++	+	+

	R3.1 – R3.2	R3.3 – R3.4	R3.5 – R3.6	R3.7 – R3.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
The number of people who are warned in advance increased	+	+/-	+/-	+/-	++	++
Vulnerable natural ecosystems strengthened	++	+	+/-	+/-	++	++
Active, skilled and materialised local response team	+	+	+/-	+/-	++	++
People trained regarding climate change and adaptation	++	+	+/-	+/-	++	++

Expected impact of the benefits on interventions:

- ++ = High impact on benefits anticipated
- + = Medium impact on benefits anticipated
- +/- = Low impact on benefits anticipated

4.1.4 Mutimbuzi region

Main objective is to mitigate flood risk and harness flood- and rainwater for irrigation purposes in the Mutimbuzi sub-basin; its river network is depicted in Figure 28.



Figure 28: River network in the Mutimbuzi sub-basin

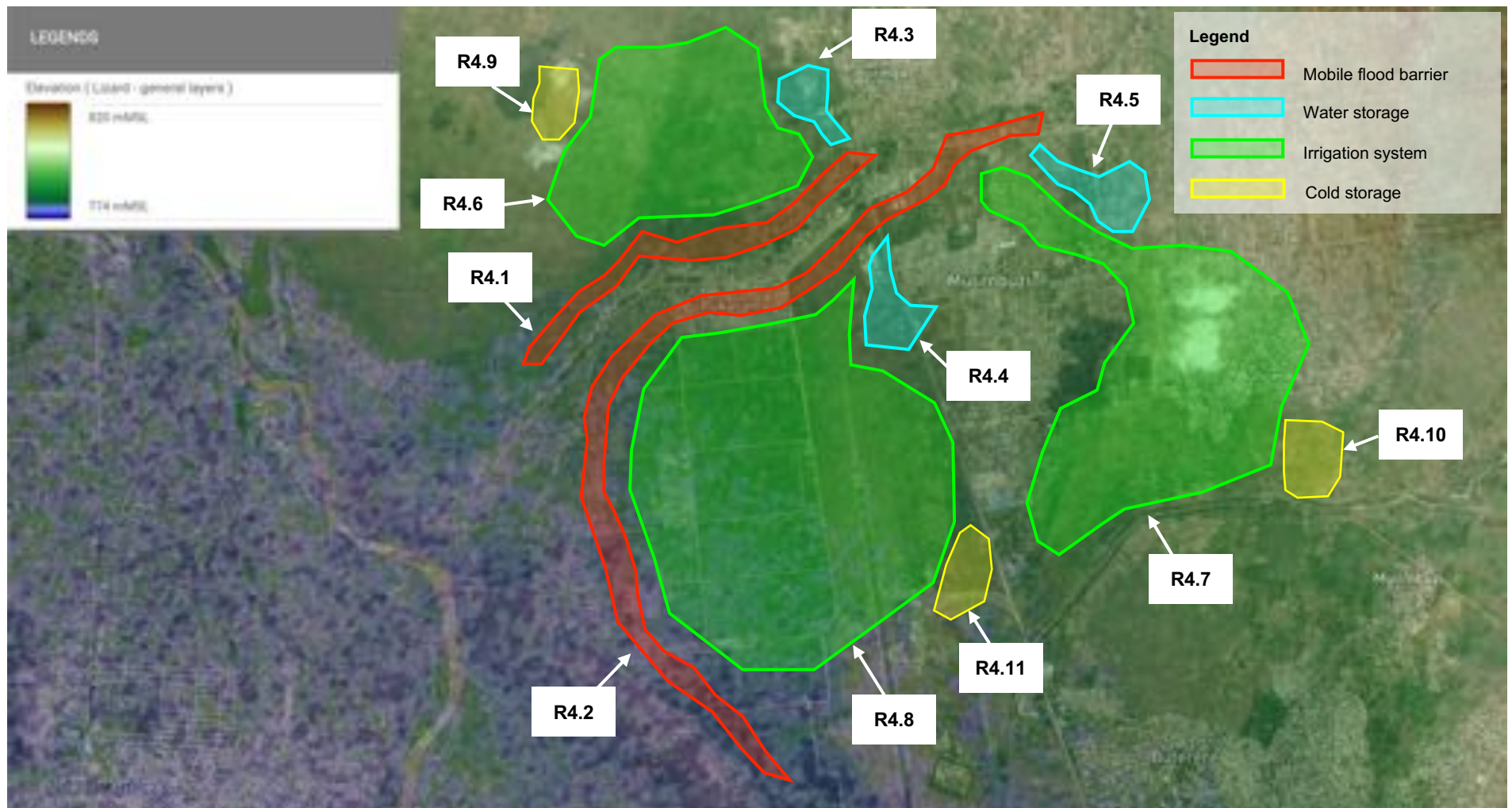


Figure 29: Potential locations in the Mutimbuzi sub-basin to implement measures

Proposed interventions

This study assessed where the different adaptation measures could be implemented in the Mutimbuzi sub-basin as shown in Figure 29. These locations have been selected using hydrodynamic modeling software. Table 19 below provides a description of the different adaptation measures at the proposed locations.

Table 19: Proposed interventions in Mutimbuzi

Intervention	Description
R4.1 – R4.2 Water-filled mobile flood barrier	There is a high risk of riverine flooding during flood season when water levels of the Ruzizi River rise. Two locations alongside the river are proposed where the mobile flood barrier could be deployed to ensure that the agricultural land and the settlements in Mutimbuzi are protected from flooding.
R4.3 – R4.5 Water harvesting infrastructure	Flood- and rainwater are harnessed upstream using the mobile flood barrier to redirect waterflows of the Ruzizi River. Water is stored in the mobile flood barrier and in engineered lakes to use it for irrigation or drinking water purposes in times of drought. Three locations for the lakes are proposed, one for each consequent deployed mobile flood barrier.
R4.6 – R4.8 Pumping and irrigation system	The harnessed water is pumped out from the lakes and flows downstream through an irrigation system. This process ensures that large areas of agricultural land can be used for crops production even during dry season. Each of the lakes comes with a pumping and irrigation system. Solar pumps and gravity enable a flow of water using clean energy.
R4.9 – R4.11 Solar-powered cold storage	Crops and livestock products are stored in a solar-powered cold storage unit. Cold storage enhances the lifespan of food products therewith improving food security and the economy. The solar panels ensure that clean energy is used to preserve food products.
Information technology	Abovementioned adaptation measures are supported by information technology solutions including (i) hydrodynamic modeling software, (ii) FIS, (iii) the Optimal Dam Locator and (iv) EWSs.
Adaptation practices	Local stakeholders shall undergo capacity building workshops and trainings to mitigate flood and drought risks using the implemented adaptation measures.

A qualitative evaluation of the benefits per adaptation measure at the proposed locations is depicted in Table 20 below.

Table 20: Anticipated impact interventions in the Mutimbuzi sub-basin

	R4.1 – R4.2	R4.3 – R4.5	R4.6 – R4.8	R4.9 – R4.11		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
Assets and people made more resilient to flood and drought	++	++	+	+/-	++	+
Livelihoods and sources of income strengthened	+	++	++	++	+	+

	R4.1 – R4.2	R4.3 – R4.5	R4.6 – R4.8	R4.9 – R4.11		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
The number of people who are warned in advance increased	+	+/-	+/-	+/-	++	++
Vulnerable natural ecosystems strengthened	++	+	+/-	+/-	++	++
Active, skilled and materialised local response team	+	+	+/-	+/-	++	++
People trained regarding climate change and adaptation	++	+	+/-	+/-	++	++

Expected impact of the benefits on interventions:

- ++ = High impact on benefits anticipated
- + = Medium impact on benefits anticipated
- +/- = Low impact on benefits anticipated

4.1.5 Kabezi region

The main objective is to mitigate flood risk for the settlements in the Mutimbuzi sub-basin; its river network is depicted in 30.



Figure 30: River network in the Kabezi sub-basin

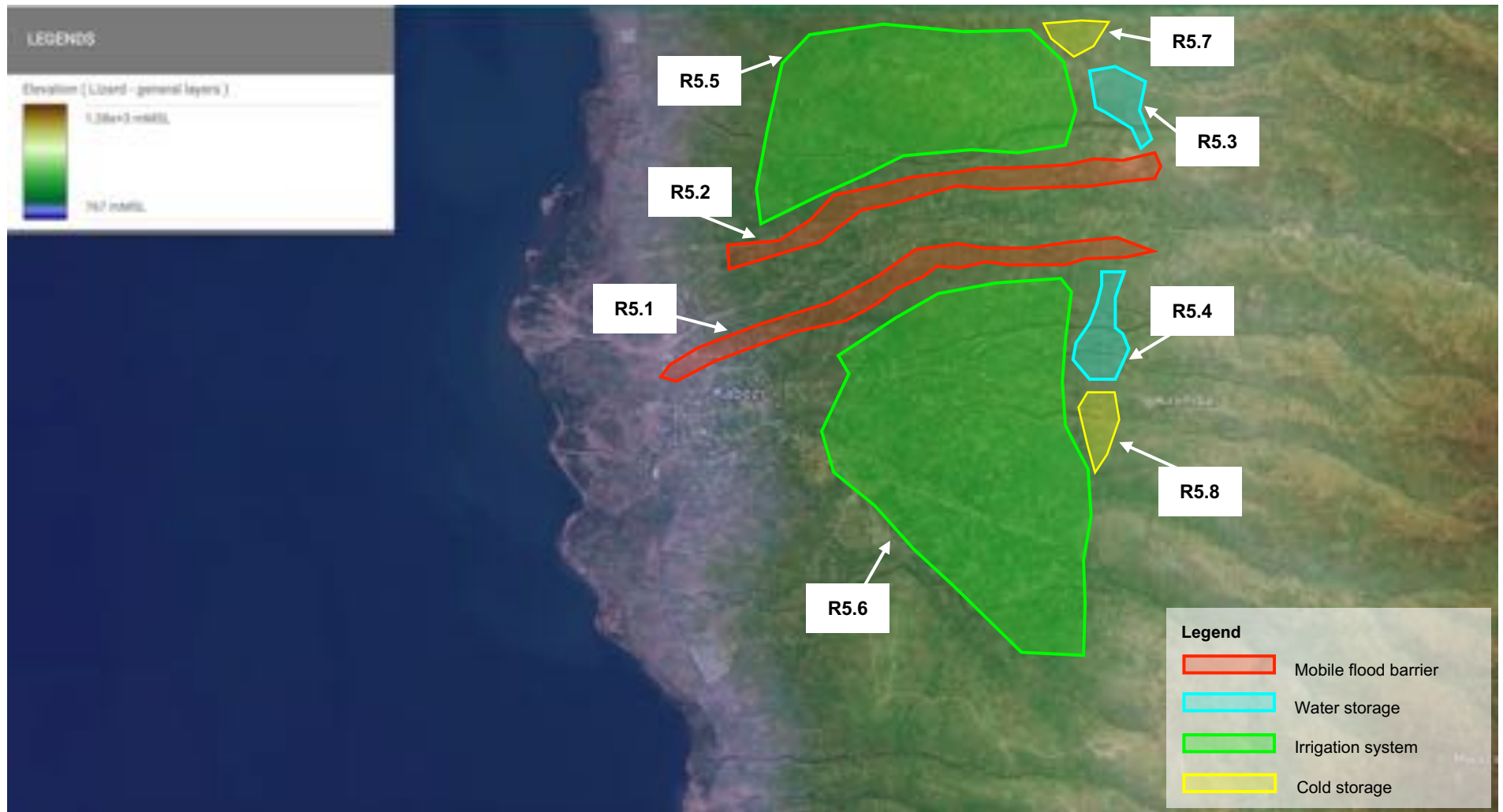


Figure 31: Potential locations in the Kabezi sub-basin to implement measures

Proposed interventions

This study assessed where the different adaptation measures could be implemented in the Kabezi sub-basin as shown in Figure 31. These locations have been selected using hydrodynamic modeling software. Table 21 below provides a description of the different adaptation measures at the proposed locations.

Table 21: Proposed interventions in Kabezi

Intervention	Description
R5.1 – R5.2 Water-filled mobile flood barrier	There is a high risk of riverine flooding in Kabezi during flood season when water levels of the Ruzizi River rise. In addition, there might be flooding due to rising water levels of the nearby Tanganyika Lake. The two proposed locations of the mobile flood barrier ensure that the agricultural land and the settlements in Kabezi are protected from flooding.
R5.3 – R5.4 Water harvesting infrastructure	Flood- and rainwater are harnessed upstream using the mobile flood barrier to redirect waterflows. Water is stored in engineered lakes to use it for irrigation or drinking water purposes in times of drought. These water retention lakes are engineered upstream on each side of the river.
R5.5 – R5.6 Pumping and irrigation system	The harnessed water is pumped out and flows downstream through an irrigation system. This process ensures that large areas of agricultural land can be used for crops production on each side of the river, even during dry season. A solar pump and gravity ensure clean energy is used to move the flow of water.
R5.7 – R5.8 Solar-powered cold storage	Crops and livestock products are stored in a solar-powered cold storage unit. Cold storage enhances the lifespan of food products therewith improving food security and the economy. Solar panels ensure that clean energy is used to preserve the food products.
Information technology	Abovementioned adaptation measures are supported by information technology solutions including (i) hydrodynamic modeling software, (ii) FIS, (iii) the Optimal Dam Locator and (iv) EWSs.
Adaptation practices	Local stakeholders shall undergo capacity building workshops and trainings to mitigate flood and drought risks using the implemented adaptation measures.

A qualitative evaluation of the benefits per adaptation measure at the proposed locations is depicted in Table 22 below.

Table 22: Anticipated impact interventions in the Kabezi sub-basin

	R5.1 – R5.2	R5.3 – R5.4	R5.5 – R5.6	R5.7 – R5.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
Assets and people made more resilient to flood and drought	++	++	+	+/-	++	+
Livelihoods and sources of income strengthened	+	++	++	++	+	+

	R5.1 – R5.2	R5.3 – R5.4	R5.5 – R5.6	R5.7 – R5.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
The number of people who are warned in advance increased	+	+/-	+/-	+/-	++	++
Vulnerable natural ecosystems strengthened	++	+	+/-	+/-	++	++
Active, skilled and materialised local response team	+	+	+/-	+/-	++	++
People trained regarding climate change and adaptation	++	+	+/-	+/-	++	++

Expected impact of the benefits on interventions:

- ++ = High impact on benefits anticipated
- + = Medium impact on benefits anticipated
- +/- = Low impact on benefits anticipated

4.1.6 Mpanda region

The main objective is to mitigate flood risk and harness flood- and rainwater for irrigation purposes in the Mpanda sub-basin; its river network is depicted in Figure 32.



Figure 32: River network in the Mpanda sub-basin

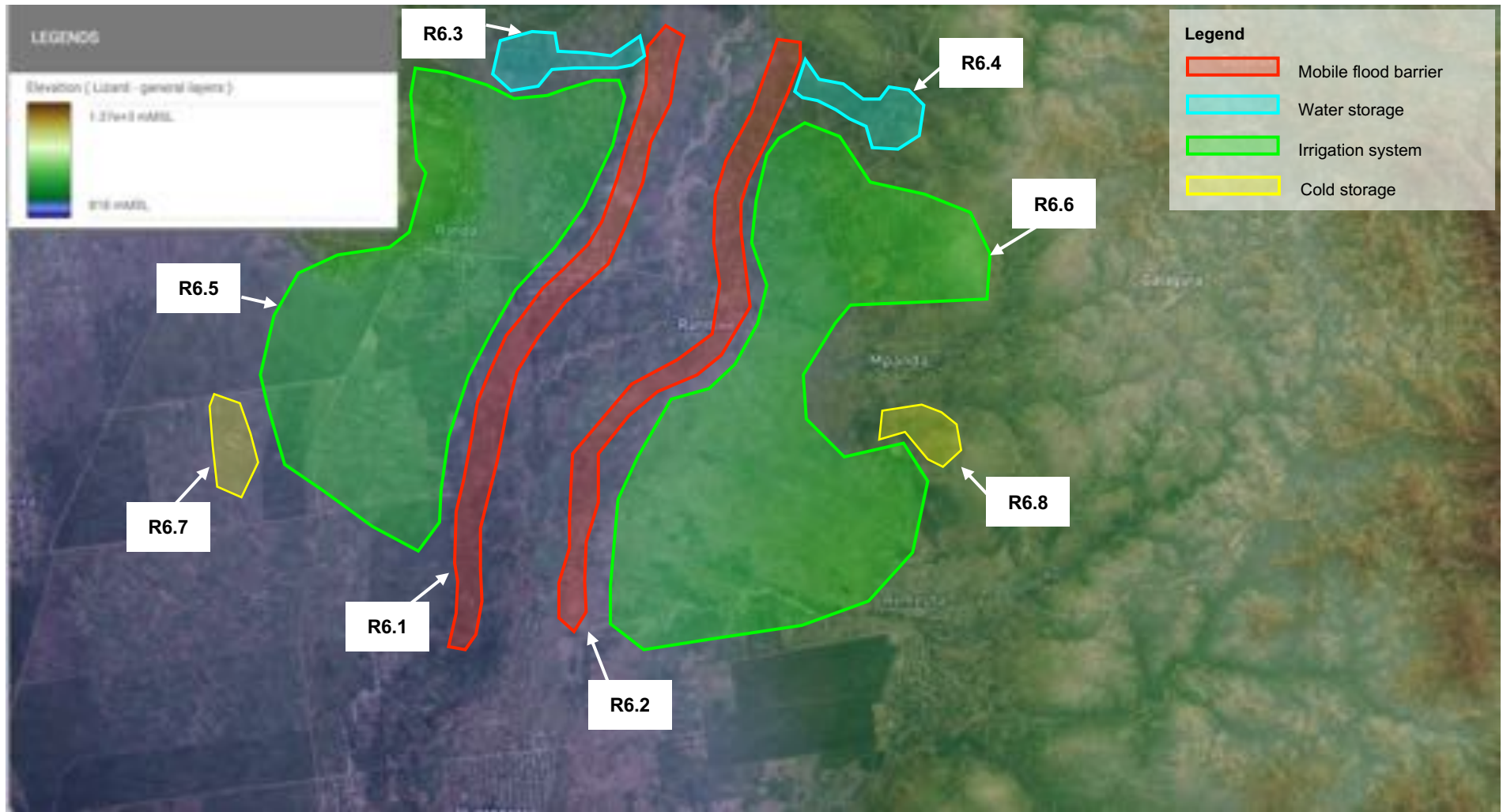


Figure 33: Potential locations in the Mpanda sub-basin to implement measures

Proposed interventions

This study assessed where the different adaptation measures could be implemented in the Mpanda sub-basin as shown in Figure 33. These locations have been selected using hydrodynamic modeling software. Table 23 below provides a description of the different adaptation measures at the proposed locations.

Table 23: Proposed interventions in Mpanda

Intervention	Description
R6.1 – R6.2 Water-filled mobile flood barrier	There is a high risk of riverine flooding during flood season when water levels rise. The proposed positions of the mobile flood barrier ensures that the agricultural land and the communities in Mpanda are protected from flooding. The proposal is to deploy the mobile flood barrier at both sides of the river.
R6.3 – R6.4 Water harvesting infrastructure	Flood- and rainwater are harnessed upstream using the mobile flood barrier to redirect waterflows. Redirecting the flow of water is done by establishing a corridor with the mobile flood barrier. Water is stored in engineered lakes to use it for irrigation or drinking water purposes in times of drought.
R6.5 – R6.6 Pumping and irrigation system	The harnessed water is pumped out and flows downstream through an irrigation system. This process ensures large areas of agricultural land can be used for crops production even during dry season.
R6.7 – R6.8 Solar-powered cold storage	Crops and livestock products are stored in a solar-powered cold storage unit. Cold storage enhances the lifespan of food products therewith improving food security and the economy.
Information technology	Abovementioned adaptation measures are supported by information technology solutions including (i) hydrodynamic modeling software, (ii) FIS, (iii) the Optimal Dam Locator and (iv) EWSs.
Adaptation practices	Local stakeholders shall undergo capacity building workshops and trainings to mitigate flood and drought risks using the implemented adaptation measures.

A qualitative evaluation of the benefits per adaptation measure at the proposed locations is depicted in Table 24 below.

Table 24: Anticipated impact interventions in the Mpanda sub-basin

	R6.1 – R6.2	R6.3 – R6.4	R6.5 – R6.6	R6.7 – R6.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
Assets and people made more resilient to flood and drought	++	++	+	+/-	++	+
Livelihoods and sources of income strengthened	+	++	++	++	+	+
The number of people who are warned in advance increased	+	+/-	+/-	+/-	++	++
Vulnerable natural ecosystems strengthened	++	+	+/-	+/-	++	++

	R6.1 – R6.2	R6.3 – R6.4	R6.5 – R6.6	R6.7 – R6.8		
Benefit Area	Flood barrier	Water harvesting	Pumping/ irrigation	Solar cold storage	Inform. techno.	New practices
Active, skilled and materialised local response team	+	+	+/-	+/-	++	++
People trained regarding climate change and adaptation	++	+	+/-	+/-	++	++

Expected impact of the benefits on interventions:

- ++ = High impact on benefits anticipated
- + = Medium impact on benefits anticipated
- +/- = Low impact on benefits anticipated

5. Next steps

The programme organisation comprises of representatives of various stakeholder groups based in Burundi and the Netherlands. These representatives have a certain expertise or interest in the outcome of the programme. Steps have been taken as part of this study to identify and design the portfolio of adaptation measures to mitigate flood and drought risk at various climate sensitive locations in Burundi. This study entailed many of the same members as with the project organisation of the pilot project that concluded in 2022. This study helped strengthen the partnership and developed a common understanding of the conditions and requirements for implementing the adaptation measures in the Imbo Basin. Preparations have also started to design and implement large-scale interventions centered around the water-filled mobile flood barrier in the region.

This chapter includes a description of the steps that have already been taken and an analysis of the next steps. This analysis is based on the programme organisation’s experience and the knowledge acquired from the local conditions.

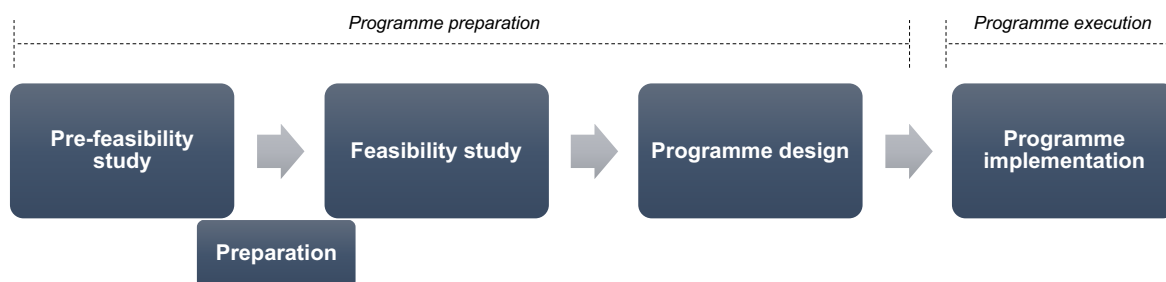


Figure 34: Stages from pre-feasibility to a pilot project

Figure 34 (adapted from Figure 2) reflects the next phases including a new step between pre-feasibility and feasibility. Each phase contains a number of actions described in the following paragraphs. Less attention has been given to the latest phases of the diagram, viz. “Programme design” and “Programme implementation”, as their implementation is strongly depended on the feasibility phase. The actions presented in each phase are, to the extent that this is possible, in chronological order.

5.1 Pre-feasibility phase (completed)

This study has been submitted with relevant stakeholders after various reviews by the programme organisation; this phase is therefore considered to be completed. An overview of the actions that have been finalised up until now is outlined below.

Pilot project in Bubanza Province completed

Although not necessarily part of the pre-feasibility phase, a pilot project has been completed in 2022 to demonstrate the effectiveness of a water-filled mobile flood barrier. The outcome and experience of that project is incorporated in this study. The President of Burundi presented the pilot project during COP27 in Egypt; this signifies the level of interest in innovative flood and drought technologies.

Situation analysis

A study confirming the viability of the adaptation measures from both a technical and a political standpoint (e.g. buy-in from key stakeholders, suitable space and topography to implement adaptation measures centered around the water-filled mobile flood barrier, etc.).

Hydrodynamic analysis

Locations have been proposed where the adaptation measures can be implemented using hydrodynamic modelling software. Reliable hydrodynamic models haven't been developed yet due to the lack of (local specific) hydrological and area data.

Consultation with local stakeholders

Initial virtual and physical meetings with all various stakeholder groups at national and sub-national level to inform them of the planned programme and request initial feedback. These local stakeholders include (i) The Ministry of Environment, Agriculture and Livestock, (ii) Local farmers and pastoralists, (iii) The Youth Bank, (iv) Women's representatives, (v) Local NGO, (vi) Local Hydrologists and (vii) UN representatives.

Capacity building workshop

Workshop in the Mpanda Commune in the Bubanza Province boosting local capabilities to identify risks and adopt effective solutions with a focus on the water-filled mobile flood barrier. Participants were from an NGO and the local community including farmers and pastoralists and from the Ministry of Environment, Agriculture and Livestock.

Pre-feasibility study

A preliminary assessment of the feasibility of the unique combination of flood and drought adaptation measures, centered around the mobile flood barrier, and their ability to deliver critical services, including flood and drought risk reduction.

5.2 Preparation for feasibility study

A communication framework shall be established to ensure adequate sharing of information on the progress of the submitted pre-feasibility study and the subsequent phases. The next steps shall be discussed and planned with relevant members of the programme organisation. Finally, a funding process for the feasibility phase shall be addressed.

Consultation with local authorities

A round of meetings with local stakeholders shall be organised, aiming to present the outcome of the pre-feasibility study. These meetings shall also function as consultation sessions to obtain their feedback on the study. Their feedback shall be considered in the next phases. The target audience shall be identified by key members of the programme organisation.

Meeting with competent authorities

Following (or in parallel to) the previous step, meetings with the Ministry of Environment, Agriculture and Livestock shall be pursued to urge for support of the proposed interventions by the central government and competent authorities.

Funding process defined and executed

The funding/financing process for implementing the feasibility phase shall be defined and all necessary actions (identification of the beneficiary, preparing the contract, etc.) shall be made.

5.3 Feasibility phase

The proposed objectives of the feasibility study are to test whether a specific viable portfolio of flood and drought adaptation measures exists that can achieve outcomes and attract commitments from stakeholders. The feasibility study follows a participatory approach by actively involving the ultimate beneficiaries (community members, farmers etc.) and other stakeholder groups including vulnerable and marginalized groups. Technical studies, including mapping, hydrological modelling, adaptation benefit analyses shall be conducted in this phase. The programme organisation furthermore proposes to collect local specific data through field visits and local datasets such as LiDAR data. These data, in combination with local expertise and state-of-the-art software, enable a common understanding of flood and drought risks and the adaptation benefits from implementing interventions. This phase aims to create a powerful centralised vision, supported by the various stakeholder groups, and to operationalise the investment plan.

Stakeholder mapping

Appropriate governance processes are critical in determining the successful outcomes of the proposed adaptation measures. A stakeholder analysis must be carried out to identify and engage the full range of people and institutions that may be affected by the proposed interventions. The process also needs to identify stakeholders who may be negatively affected and afford opportunities for their empowerment. The rights to use of and access to land and resources, along with the responsibilities of different stakeholders, must be mapped.

The study shall form partnerships between stakeholder groups as mentioned in paragraph 3.5 of this document. These partnerships shall co-design the combination of adaptation measures to mitigate flood and drought risk. This co-design process is aligned with the goal to follow a participatory approach in designing and implementing the programme. It is imperative to utilize expertise and ensure the interests of the different stakeholders are considered in the final design of the programme. This process also requires the programme to establish ownership with local people and authorities.

The programme prioritized the interests and input of vulnerable and marginalized groups to ensure that they will benefit from the implementation of the adaptation measures.

Grievance or dispute settlement mechanism

A grievance or dispute settlement mechanism shall be adopted early on, whether it be a formal legal process or an informal non-legal system. This mechanism shall have agreed procedures, roles and rules for receiving and adjudicating such disputes. The grievance mechanism shall be legitimate, accessible, predictable, equitable, transparent, rights-compatible, adaptively managed and based on engagement and dialogue.

First consultation with ultimate beneficiaries

After the first two steps of the feasibility phase, a first round of meetings with the ultimate beneficiaries (farmers, small businesses, women's representatives etc.) shall be organised. During this first meeting, the societal challenge(s) addressed must be clearly understood and documented, while significant input will be acquired in regard to risk identification and management. Finally, this process will set the basis for an inclusive, transparent and empowering governance process.

All participants in the consultation process shall be provided with a brochure/booklet that gives a high-level description of the programme. The consultation workshops and meetings aim to:

- Provide information on the proposal development processes.
- Inform partners and beneficiary populations about the project scope and objectives.
- Listen to participants' expectations and needs and take them into consideration in the design of the programme.
- Verify information collected from stakeholders and literature through triangulation.
- Suggest roles and responsibilities and their contribution to the programme.
- Outline specific actions for the most vulnerable groups such as women, and children.

Meeting with relevant authorities

In parallel to the meetings with the ultimate beneficiaries, meetings with public authorities (ministries, municipalities, regional authorities) shall be planned, aiming to inform them on the process and secure their participation. The Theory of Change (ToC) shall be presented to inform participants of the envisioned changes the programme aims to realise including outcomes, outputs, and contribution to the Sustainable Development Goals (SDGs).

It is essential in this meeting to understand the different roles and responsibilities of the various people and authorities. The feasibility study and subsequent phases of the programme require an understanding of who can provide what type of information and who has which mandates to take decisions. Support from the right authorities is critical to realise a successful outcome of the programme.

Meeting with representatives of the financial sector

The involvement of financial institutions such as African Reinsurance Corporation and the Burundi Youth Bank shall be considered early on in the process. In addition, the programme organisation shall plan meetings with other enterprises operating in the region. Insurance can improve the financial attractiveness of flood and drought mitigating programmes to investors and programme owners through better understanding of the risk/return rewards.

This is expected to enhance ownership of the approach, reduce the risks of negative unintended consequences and facilitate the overall mainstreaming of the adaptation measures into policies and sectors.

Meeting with agriculture and pastoral sectors

An first round of meetings shall be held with different actors in the agriculture and pastoral value chain including buyers of crops products. These sectors ought to benefit significantly from the programme to strengthen food security and the economy. This process shall set the basis for the crops and livestock production value chain.

Meeting with knowledge institutions

A meeting shall be scheduled with representatives of (i) the University of Delft, (ii) a University in Burundi and (iii) possibly other knowledge institutions such as Deltares to inform and involve them in the design of the programme. Their expertise can be valuable when designing the portfolio of adaptation measures to reduce flood and drought risks effectively. Their role in the programme shall also be discussed during the feasibility phase.

Establishment of a programme board

The programme board shall oversee the work to be done in the next phases. It shall consist of key Burundian experts/institutions (academia, engineering, finance) as well as international experts. The board keeps track of progress made during the feasibility study and programme design phase. The board is mandated to take decisions to remediate any issues that may arise. The programme comprises of multiple projects, each with its own project steering committee. The project steering committees shall be established during the programme design phase.

Development Adaptation Benefits Mechanism (ABM) methodology

A comprehensive ABM methodology is required to assess the anticipated benefits from implementing the flood and drought adaptation measures. This methodology guides the programme organisation on where to implement the different types of adaptation measures. This methodology provides investors/donors insight in what benefits they can expect from the investments in the adaptation measures. The assumption is that this methodology support rapid mobilization of funds to support the programme.

Hydraulic and hydrological study

A complete hydrological and hydraulic analysis is needed to assess the areas in the selected sub-basin(s) affected by flooding and drought. This study explores the hydrodynamics of the selected sub-basins to understand flood and drought risks and how to mitigate these using proposed adaptation measures. A meaningful hydraulic and hydrological study requires (i) state-of-the-art software, (ii) reliable hydraulic/area data, (iii) a data warehouse and (iv) local expertise. These analyses are an essential part of the feasibility study and subsequent phases considering that these form the foundation for taking certain decisions such as the location and timing of the deployment of the adaptation measures. An example of the hydrological study that focused on flood risk at the Mpanda Commune as part of the completed pilot project is presented in Annex 2. This particular hydrological study had limited time and resources at its disposal, nevertheless it gave insight in flood risks at the Mpanda Commune and how to mitigate these using a mobile flood barrier.

Follow-up consultations with ultimate beneficiaries

After defining the areas of intervention, follow-up meetings with the ultimate beneficiaries shall be planned. These meetings aim to get feedback on the selected areas. Furthermore, there will be initial discussions regarding the potential costs and benefits from implementing the envisioned adaptation measures to mitigate flood and drought risk.

Risk assessment

An initial risk assessment shall be developed to evaluate environmental, social and economic impacts from implementing the proposed adaptation measures at the selected locations. This Environmental, Social Impact Assessment (ESIA) considers (inter)national laws and standards when evaluating the impact of the interventions. The outcome of the risk assessment could result in a change in the design of the adaptation measures or the selected locations.

Exploring the economic viability

A key challenge for the success of the flood and drought interventions in the selected areas is incorporating their multiple benefits into a common economic evaluation framework. Three actions are foreseen within this step:

- Mapping costs and benefits: the direct and indirect benefits and costs associated with the proposed adaptation measures shall be identified and documented.
- Carrying out a cost-effective study to support the choice of the adaptation measures, including the likely impact of any relevant regulations and subsidies. The effectiveness of the design of the measures must be justified against available alternative solutions, taking into account any associated externalities.
- Considering a long-term business/financial plan to address the economic/financial feasibility and constraints of the adaptation measures. This plan shall look beyond the timeframe of the planning and initial grant-supported implementation phase.

Mainstreaming adaptation measures (including mobile flood barrier)

All the process of design and relevant actions must circulate freely and openly and should be available and accessible to all audiences. A mapping of the gaps in current policies and regulations and a mapping of the global targets relevant to the project should be carried out. Three actions are foreseen:

- Preparing a detailed communication plan for the feasibility and design phase. The plan should include tools such as newsletters on lessons learnt, press releases on partnerships formed, capacity trainings on design or implementation, policy briefs and lobbying.
- Mapping existing policies, plans, laws and regulations, and highlighting gaps in the legal framework.
- Mapping global targets relevant to the project. This will also include a mapping of the relevant national stakeholders who are responsible for these global targets.

5.4 Concept design phase

The proposed objectives of the design phase are to deliver a well-structured programme with clear associated governance and financing arrangements (i.e., a business model) for the programme's success. In addition to the typical tasks covered in the concept design phase, this phase shall involve transforming stakeholder interest into specific resource commitments

(either direct or in-kind) to ensure that the regional investment plan has firm financial footing. Furthermore, this phase shall formalize ownership of adaptation measures and roles and responsibilities throughout the programme and after programme completion.

Preparing the funding scheme for the implementation of adaptation measures

After completing the feasibility phase and reaching a consensus on the envisioned adaptation measures, centered around the mobile flood barrier, the funding of the programme shall be defined. Extended meetings with relevant national and international stakeholders shall be organised to decide on the most appropriate funding scheme. Complementary actions (e.g. contracts, etc.) should also be foreseen.

Designing a governance arrangement for adaptation measures

A proper governance structure shall be sought to ensure the sustainability of the programme. Clear responsibilities and roles of stakeholders shall be defined.

Establishment steering committees

The programme has multiple projects each with its own organisation including a steering committee. All projects shall follow the same approach and are overseen by the programme board. During the design phase, the different projects and its members shall be identified and consulted. Each project team ought to have the right capabilities to realise its objectives.

Third consultation with ultimate beneficiaries

As a part of the inclusive, transparent and empowering governance processes, meetings with the ultimate beneficiaries shall be organised again in the design phase. The local stakeholders shall be made aware of the feasibility phase results and informed on the specific steps of the concept design phase.

Actions and safeguards for trade-offs

Trade-offs can be successfully managed if consequences are properly assessed, fully disclosed and agreed-upon by the most affected stakeholders. Fair and transparent negotiations, and compensation for any loss as a result of the adaptation measures are significant characteristics of good trade-offs. The potential costs and benefits of associated trade-offs of the adaptation measures in the areas of concern will be explicitly acknowledged and inform safeguards and any appropriate corrective actions. Additional meetings with the ultimate beneficiaries should also been foreseen at this stage.

Meeting with relevant authorities

Meetings with relevant stakeholders (ministries, regional authorities and municipalities) shall be planned to start preparing a more specific flood and drought adaptation strategy and an operational plan.

Co-design solution

Stakeholder groups that take part in the co-design process shall develop a final approved design of the solution that shall be implemented at the agreed locations. All stakeholder groups, including vulnerable and marginalized groups, have to agree and sign-off on the final design of the solution.

Development full proposal

The full proposal will be developed in accordance with the requirements of the donor(s) that

help fund the programme. The full proposal shall be reviewed and approved by relevant stakeholders before it is submitted.

5.5 Execution phase

The proposed objectives of the execution phase are to clearly establish the implementation entity of the programme and outline its operational structure, as well as to mobilise implementation capacity to deliver the combination of adaptation measures centered around the mobile flood barrier. This phase includes all elements of the project execution including procurement, detailed design, finance, construction, operation, monitoring and maintenance. The programme follows the Prince 2 methodology and shall monitor progress and make decisions regarding exceptions in terms of (i) costs, (ii) quality, (iii) features and (iv) time.

6. Conclusions

The present study has conducted a preliminary assessment of the feasibility of the unique combination of adaptation measures, centered around the water-filled mobile flood barrier, in the Imbo Basin in Burundi to mitigate the risk of flood and drought. In the medium and long-term, the study aims to initiate a programme including the studied adaptation measures in the Imbo Basin. This pre-feasibility report is the first step towards this objective.

Flood and drought events, exacerbated due to climate change, have a destructive impact on (i) people, (ii) environment and the (iii) economy on regional and national level. Large parts of the Imbo Basin are characterised as areas of potentially significant flood and drought risk. Farmers and pastoralists suffer perhaps the most from flood and drought risks due to the negative impact on food production, which in turn jeopardizes food security and livelihoods. Compared to other developing countries, Burundi is less ready to combat the negative impacts of climate change. Past actions to enhance resilience to flood and drought risk in the region are limited and have proven to be ineffective.

A pilot project has been implemented in 2022 that aimed to demonstrate the effectiveness of a water-filled mobile flood barrier to enhance resilience to flood and drought risk. This project was completed successfully and to the satisfaction of local stakeholders, so much so that the President of Burundi presented this during COP27 in Egypt. Due to its success, it was decided to scale up this technology in Burundi to increase the realization of flood and drought adaptation benefits. It was furthermore decided to expand not only the regional scope but also the scope of the products and services to mitigate flood and drought risk. A unique combination of innovative solutions has been designed centered around the mobile flood barrier.

There is a regulatory framework in place on national and sub-national level that focuses on relevant areas including: (i) water management, (ii) climate adaptation, (iii) flood and drought management, (iv) disaster management. Flood and drought risk reduction is one of the highest priorities of the country considering its disastrous impact. The country is to a great extent still exploring how best to mitigate flood and drought risks and are therefore open to innovative solutions such as mobile flood barriers.

Through the stakeholder engagement with (i) ministries, (ii) UNEP, (iii) the Adaptation Fund, (iv) a local NGO, (v) communities, (vi) farmers, (vii) academic institutions and a (viii) financial institution, this study confirms that moving forward with a feasibility study is possible, both from a technical and a political standpoint. This study has identified a portfolio of flood and drought adaptation measures centered around the mobile flood barrier to realise significant adaptation benefits. The study has also identified possible locations where these solutions can be implemented, yet to be verified during the feasibility study.

The cost of the different measures depends on factors such as (i) the cost of work and (raw) materials, (ii) the size of the proposed interventions and their specific location, (iii) maintenance, and (iv) operation costs. Cost estimates are typically done in later phases, since more data is required for the cost analysis. This study does provide a budget for the feasibility phase. The investment in the feasibility study is required to ensure a reliable outcome of the study on which the subsequent phases are built.

The programme team has the proven expertise to address all the above considerations to implement the programme in the Imbo Basin and scale-up the combination of adaptation measures in other regions and countries. The feasibility study shall be carried out in collaboration with key Dutch and Burundian experts, including representatives of (i) marginalized and vulnerable groups, (ii) local communities, (iii) farmers and pastoralists, (iv) academia, (v) the financial sector, (vi) engineering companies and (vii) institutions in charge of flood and drought mitigation. The programme team has developed a better understanding of the particular challenges faced by this region and developed a wide network of local contacts that would prove invaluable to the implementation of the proposed adaptation measures centered around the mobile flood barrier.

Annex 1: Overview anticipated benefits

Table: Benefits from implementing the combination of measures

<i>Project outcome</i>	<i>Economic benefits</i>	<i>Social benefits</i>	<i>Environmental benefits</i>
<i>Outcome 1.1: Increased use of effective information technology by stakeholders.</i>	<ul style="list-style-type: none"> Enhanced understanding on how to extract the most economic value of adaptation practices, tools and technologies. Decrease in financial damages due to timely and effective disaster response enabled by information services. Increase in crops and livestock production through smart agriculture and software/apps. 	<ul style="list-style-type: none"> Information services (e.g. early warning) will prevent human loss, injuries and diseases. Protecting social assets through the implementation of information services. Enhanced livelihoods by effective disaster management through information services. The information will provide input to the population to adapt agricultural practices. 	<ul style="list-style-type: none"> A better understanding of how the environment is impacted by floods and drought and how to protect the environment. More efficient and effective utilization of natural resources through information services.
<i>Outcome 2.1: Increased uptake and usage of concrete and innovative flood adaptation actions.</i>	<ul style="list-style-type: none"> Prevention of direct and indirect financial damages caused by flooding. Increase in crops and livestock production by preventing inundation of (agricultural) land. Creation of new jobs to support flood disaster management. 	<ul style="list-style-type: none"> Reduced loss of human lives, injuries and diseases. Improved quality of life through increase in jobs and income. Reducing social unrest, conflicts and, migration of community members because their livelihoods were destroyed by floods. Protection of damages to social assets such as schools and healthcare facilities. 	<ul style="list-style-type: none"> Protection of biodiversity and (agricultural) land from flood damages. Prevention of land erosion caused by flood events.

Project outcome	Economic benefits	Social benefits	Environmental benefits
Outcome 2.2: Increased uptake and usage of concrete and innovative drought adaptation actions.	<ul style="list-style-type: none"> • Increase in crops and livestock production through enhanced water availability and water harvesting and irrigation structure. • Creation of new businesses due to increase in arable land. • Creation of new jobs to support drought disaster management. 	<ul style="list-style-type: none"> • Enhancing of food and water security for the drought-affected populations. • Improved quality of life through increase in jobs and income. • Increase availability of drinkable water. • Reducing social unrest, conflicts and, migration of community members seeking water and other sources of livelihoods 	<ul style="list-style-type: none"> • Enhanced water availability for human and livestock populations and arable land. • Increase in efficient usage of water. • Improved protection and restoration of ecosystems through the uptake in availability of water. • Improved land management/conservation infrastructure, leading to reduced soil loss and increased quantity of agricultural produce.
Outcome 3.1: Flood and drought resilience of key stakeholders at regional, national and local levels strengthened.	<ul style="list-style-type: none"> • Improved capabilities to create economic value from flood and drought resilient adaptation practices, tools and technologies. 	<ul style="list-style-type: none"> • Flood and drought management plans bring together various (public and private) organisations at all levels of society. 	<ul style="list-style-type: none"> • Equal distribution of land and water to support the environment and the population.
Outcome 3.2: Partnerships for flood and drought management at regional, national and local levels strengthened.	<ul style="list-style-type: none"> • Creation of new jobs by intensified collaboration between different organisations and communities. • Improved value chain related to crops and livestock products to increase economic value. 	<ul style="list-style-type: none"> • The participation and involvement of people will contribute to develop long-term sustainable products and services which will be beneficial in increasing personal and national growth. 	<ul style="list-style-type: none"> • Improved “checks and balances” to ensure protection, restoration and management of the environment.
Outcome 4.1: Knowledge and awareness on flood and drought risks management is increased.	<ul style="list-style-type: none"> • Increase in availability of national expertise decreases the costs for external knowhow. 	<ul style="list-style-type: none"> • Adaptive capacity of communities to flood. and drought increased. • General raising of awareness of impact of climate change to the community and the need for an enhanced role by the community 	<ul style="list-style-type: none"> • Improved understanding amongst various organisations and communities on how to protect the environment.

<i>Project outcome</i>	<i>Economic benefits</i>	<i>Social benefits</i>	<i>Environmental benefits</i>
		<ul style="list-style-type: none">• Strengthening the active participation of vulnerable populations in decisions linked to climate change.	

Annex 2: Example hydrological study

Bubanza province is one of the 18 provinces in Burundi with 338.023 habitants. In this project we focus on the catchment area containing the Mpanda and Musenyi rivers, see Figure 1. Within this catchment the inhabitants face flood challenges because of high intensity rainfall and large river discharges and drought challenges due to water deficit. Within the catchment, two specific locations are indicated as most vulnerable areas. Namely, Gahwazi II in the North and Rubira in the South, see Figure 2.

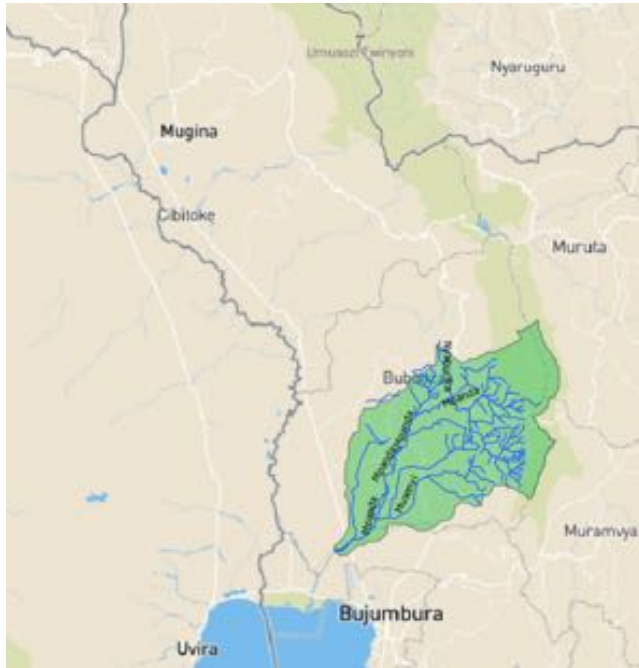


Figure 1: Catchment and rivers of Rubira Hills



Figure 2: Vulnerable areas in the Mpanda

Field visit

During a field visit Gahwazi II and Rubira we performed interviews with inhabitants of the community to get more insight into the flood and drought challenges. For each location, ten inhabitants have been interviewed to discover flood extents, water depths, and flood recurrence times and on cultivated commodities, irrigation possibilities, and drought recurrence times. The interview questions can be found in field visit report.

Next to the interviews, some additional information and pictures have been gathered during the field visit. The information of the field visit is used as input for the hydrodynamic model and for the SLAMDAM site selection. The paragraphs below describe the main conclusions from the field visit for Gahwazi II and Rubira.

RUBIRA SITE: The Rubira site is located in the Mpanda and Gihanga communes.

GAHWAZI SITE: The GAHWAZI site is located in the communes of Mpanda, Gihanga and Bubanza. It is located upstream from the Rubira site. From the geographical point of view, the two sites in the region of Imbo having altitudes between 774 m, level of Lake Tanganyika and 1000 m at the beginning of the coastal escarpments of Mimirwa.

The area has a tropical climate with a long dry season which lasts 4 to 5 months from June to September or October. It experiences a long rainy season from October or November followed by a short dry season in February which precedes the short rainy season from March to May. However, this climate is variable depending on the relief. The dry season becomes very severe and longer in the Imbo plain than in the heights of Mumirwa. The natural vegetation has completely disappeared and artificial afforestation is rare in the project area.

The average annual rainfall varies from 800 to 1000 mm while the average temperature is 27°C. Regarding hydrography, the Mpanda commune is crossed by 10 rivers, namely 4 rivers (Mpanda, Gifurwe, Nyakadahwe and Musenyi) and 6 streams (Kidwebezi, Kazirabagore, Nyamuyumpu or Gahwazi, Gatagura, Nzorya).

Soils: The plain part has loamy clay soils while the Mumirwa is mostly occupied by loamy gravelly soils. In Imbo, the soils are destroyed by the climate on the one hand and overexploitation on the other. The fertility exported by the crops of one season is often not returned to the following season on the pretext that the soils are not eroding. The unidirectional impoverishment caused by the exploitation for several years of the same crop always drawing the same elements from the soil is a handicap for the soils occupied by the rice fields of the plain.

Table 1: Population des communes de la province bubanza en 2008 et projection 2022: densité 310 hab/km² en 2008 et 425 hab/km².

Nom de commune	Sexe		Population 2008	Projection 2022
	1. Masculin	2. Féminin		
Bubanza	42 062	41 616	83 678	114 261
Gihanga	30 339	25 005	55 344	75 571
Mpanda	29 313	29 600	58 913	80 445
Musigati	41 035	41 172	82 207	112 252
Rugazi	31 719	26 162	57 881	79 036
Total	174 468	163 555	338 023	461 565

Current Situation

The population is more than 95% of the agricultural population the agricultural sector, which is practiced over an area of about 35 ares per household, is characterized by subsistence agriculture, the use of rudimentary tools (hoes), a lack of improved inputs and the use of manual labor. essentially family work. This results in generally low yields with insufficient production.

The main food crops grown in both areas include beans, soybeans, rice, cassava, banana, maize, sweet potato. Cash crops: Oil palm is the main cash crop grown, unfortunately, there is no supervision structure in place even though it generates fairly substantial income for rural households in the project area. Vegetable crops: The vegetable crops practiced in the project area are: tomato, eggplant, cabbage, onion, pepper, cucumber. These vegetable crops are grown on a small scale in the municipality due to the scarcity of related inputs, namely fertilizers, pesticides and quality seeds.

- The season which goes from September to February called: season A
- The season which goes from March to June called: Season B
- The season which goes from June to December: for crops the irrigated perimeters:
Season C

The association of cultures is the predominant mode of culture with associations of three to four cultures except for the rice perimeters. 100% of the land is occupied by crops in the plains. There is no fallow land due to the scarcity of the land. Irrigation is practiced in the irrigated perimeters with an area of 4029 Ha including 1695 Ha in Gihanga commune, 563 Ha in Mpanda commune and 500 Ha for Bubanza.

Animal production

Livestock farming practiced in the area is of the traditional type and consists of cattle, goats, sheep, pigs and poultry. But the vast majority of animals raised in the area are local breeds and rarely receive basic health care.

A few people practice livestock in permanent stalls, but it is the people who have sufficient financial means insofar as they buy herbs daily to feed the cattle following the atomization of the land which is a real problem and is due to the strong demographic pressure

During the rainy season, the Mpanda river which separates Mpanda commune from Bubanza and Gihanga communes overflows its bed and very often causes flooding of fields in the Mpanda valley in the far west of Mpanda commune and in the far east. of Bubanza and Gihanga communes. These floods cause a strong loss of food production since they are almost regular and occur before the harvest and the waters stagnate for a long time in the fields.

Two areas have been identified:

1. Gahwazi area located upstream North
 - The site is located in the Mpanda, Bubanza and Gihanga communes.
 - The flooded area is located along the banks of the Mpanda River, upstream downstream of the RN 9.
 - The flooded area is larger: 213.62 Ha
2. Rubira area located upstream-south
 - The site is located in the Mpanda and Gihanga communes.
 - The flooded area is along the banks of the Mpanda River
 - The flooded areas are small: 27.27 Ha.



Figure 3: Catchment and rivers of Rubira Hills

In this area, two types of crops are grown:

- Perennial crops: oil palms, banana trees.
- Seasonal crops: rice, sweet potato, bean, soybean, corn, tomato

During floods:

Perennial crops are not affected. Seasonal crops are affected in different ways depending on whether they can adapt underwater. For rice that can adapt under water, there are no yield losses if flooding occurs before flowering, on the other hand if flooding occurs after flowering but not on the day of harvest 50 % of the expected return is lost. If, on the other hand, the flood occurs on the day of the harvest, 100% of the production is lost.

For plants that cannot adapt under water such as sweet potatoes, beans, soybeans, corn, tomatoes 100% of the production is lost in the event of flooding.

public infrastructure such as bridges, including the one that connects the economic capital Bujumbura and the capital of the province Bubanza are threatened by these floods

A drinking water supply is also threatened by the floods which partially dug up the pipes
 Apart from floods, the project area suffers from water deficit during the dry season except for irrigated areas representing less than 1% of agricultural areas where 3 crops are harvested per year while in non-irrigated areas two crops are harvested per year.

Rubira



Figure 4: Pictures of Rubira during field visit

Gahwazi



Figure 5: Pictures of Gahwazi during field visit

Hydrodynamic modelling method

In the project we make use of a hydrodynamic model to simulate hydrodynamics of a particular flood cases. There are three reasons to make use of a hydrodynamic model:

- 1) to visualize and understand the hydrodynamics of the model
- 2) to simulate previous flood events
- 3) to determine the effect of SLAMDAM

Based on field visits, local expertise, and available data, we constructed a hydrodynamic model. The paragraphs below elaborate on the configuration of the model.

Hydrodynamic model configuration

The model software used for the hydrodynamic model is 3Di. 3Di is state-of-the-art hydrodynamic simulation software for pluvial, fluvial and coastal floods. 3Di is applied in both urban and rural areas around the world. Unique about 3Di is the combination of fast simulations, interactive modelling, detail of the schematisation and the advanced capabilities to model hydrodynamic processes. For more information about 3Di, see <https://3diwatermanagement.com/>

The hydrodynamic model uses several raster layers as input. Table 2 lists the raster layers with their source and resolution used as input for the model. In addition to the rasters, the model accounts for increased contraction of the flow at bridges and up- and downstream

boundary conditions.

Table 2: raster layers used as input for the hydrodynamic model

Raster layer	Source	Resolution
Digital Elevation Model (DEM)	Local government	10x10 m
Friction	Based on landcover map - ESA	10x10 m
Infiltration	Based on soil map - Food and Agriculture Organization of the United Nations	30 arc-second

4.2 Hydrodynamic simulation settings

After the model is configured with the rasters and the additional information, we can run the model with a precipitation source to simulate a certain event. For this project we selected a normative event for the floods occurring in Gahwazi II and Rubira. The floods occur mostly in the wet season, with the highest floods at the end of March until May.

To determine the precipitation intensity, used as forcing on the model, we used two sources. First, we used the daily measurements of a national weather station and estimated the 90-percentile of the precipitation in 24h in March and April. We assumed this precipitation took place within two hours. After that, we used two previous flood events as a second source and validated the derived precipitation intensities. The two flood events occurred in Bujumbura in 2018 and 2019 and are assumed to be normative events as both left fatalities and/or evacuated people. The combination of the daily precipitation measurements and previous flood events resulted in a model simulation with precipitation of 35 mm/h for two hours.

Hydrodynamic modelling results

After the completion of the configuration of the hydrodynamic model, we ran the model with a precipitation of 35 mm/h for two hours. Thus, 70 mm of precipitation in total. The results of this simulation are described below, for the entire catchment Gahwazi II and Rubira separately. All the results of the model are validated in a session with local hydrologists and the executed field work.

Hydrodynamic simulation results of the Mpanda catchment

The Mpanda catchment shows highly elevated and mountainous areas on the Eastern side, see Figure 6. Here, elevations can rise up to 920 meters. The difference in elevation with the Western side is up to 130 meters. As a result, during a precipitation event, the water is being collected in many channels in the upstream part of the catchment. When the channels are followed more downstream, they are converging into more defined rivers, such as the Mpanda river, see topmost arrow of Figure 6.

The Mpanda river continues its way to the South-Western part of the catchment. In the course of the Mpanda river, multiple side channels discharge into the river and increase the total discharge. Just to the South of Rubira, the relatively large Musenyi river discharges into the Mpanda river.

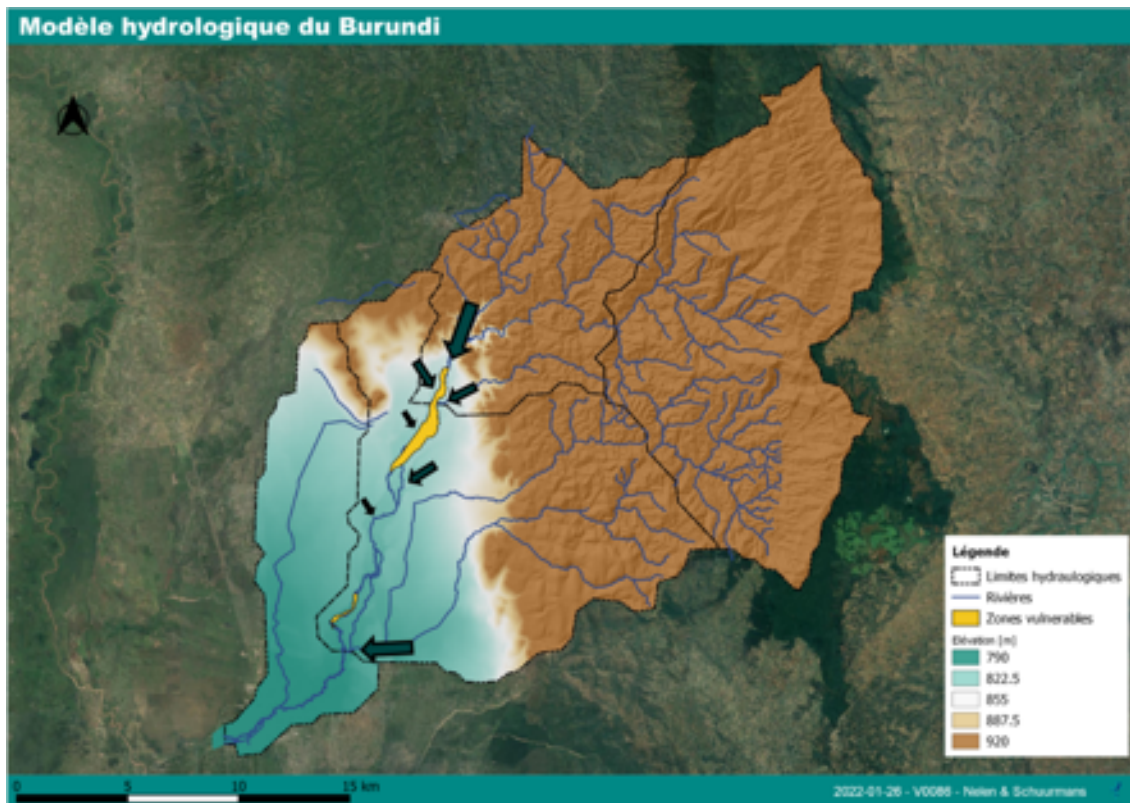


Figure 6: Functioning of the Mpanda Catchment, with the vulnerable area Gahwazi II in the North and the vulnerable area Rubira in the South.

As a result of the hydrological functioning of the catchment, where water is being collected in the streams in the upstream areas and then following its way to the South-West of the catchment, the flood arrives earlier in the upstream part of the catchment than in the downstream part of the catchment. Figure 7 shows the number of hours from the start of the simulation until the maximum water depth is reached.

As can be seen from the Figure, the maximum water depths in Gahwazi II occur after 3-5 hours from the start of the simulation. This means the maximum water depths occur one hour after the simulated precipitation to three hours after the precipitation. In contrast, the maximum water depths in Rubira occur after 5-7 hours from the start of the simulation (3-5 hours after the precipitation).

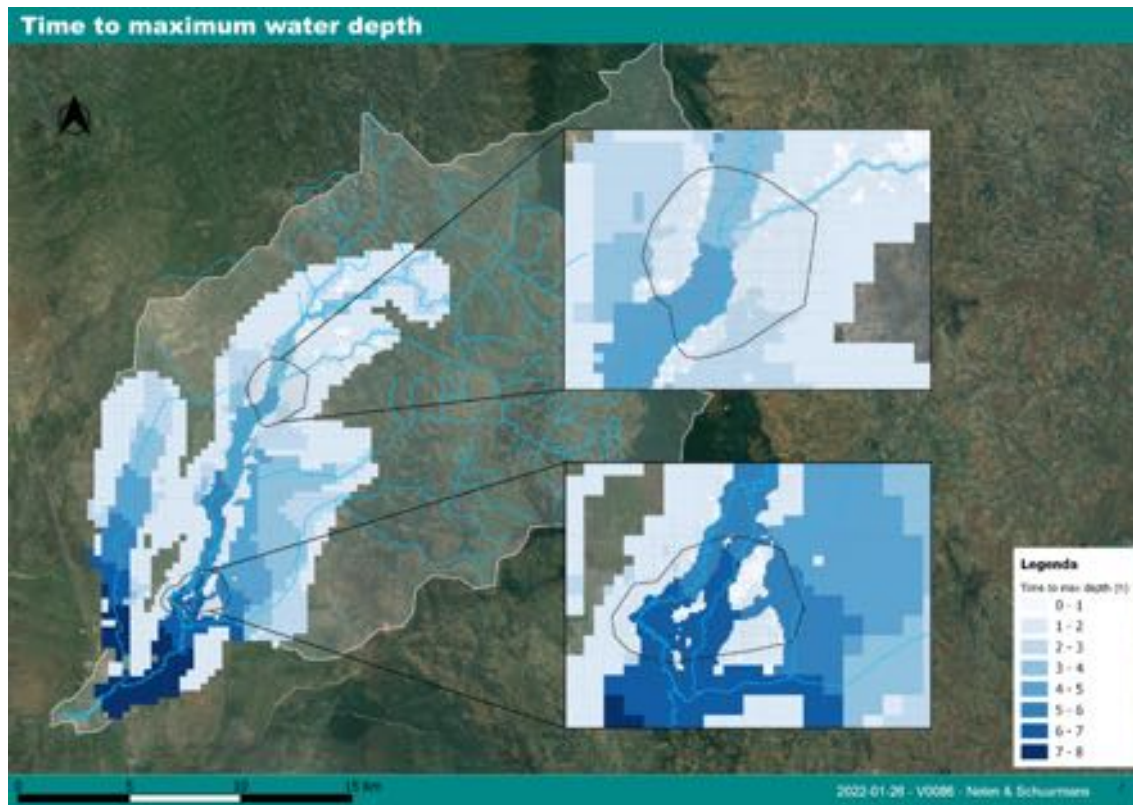


Figure 7: The time until the maximum water depth is reached in hours after the start of the simulation. The Northern location depicts Gahwazi II and the Southern location depicts Rubira.

Gahwazi II

The floods in Gahwazi II originate mainly from the upstream area in the Mpanda catchment. The Mpanda river flows through Gahwazi II where the river banks are overflowed as a result of high-water levels. Figure 8 shows the origin of water at Gahwazi II in red, which are mainly riverine sources.

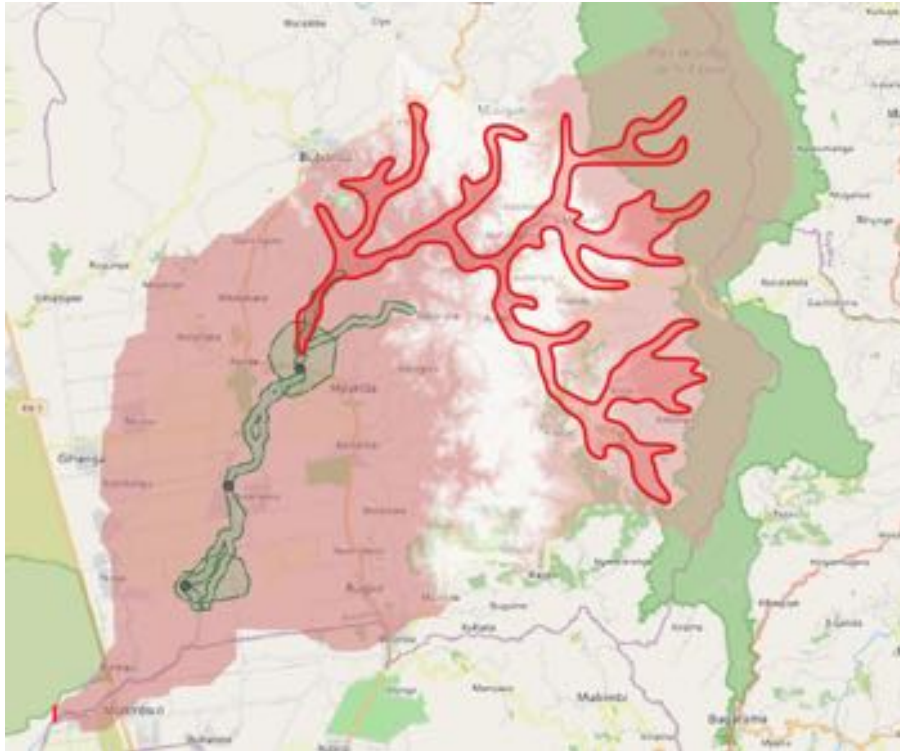


Figure 8: Sources of water causing flooding in Gahwazi II

If we take a closer look to Gahwazi II in Figure 6, we can see sources of light flooding and sever flooding. Direct rainfall-runoff causes light flooding with water depths up to 0.5 m, while riverine flooding in combination with rainfall-runoff causes severe flooding up to 2 m. The timing of the maximum water depths occurring from rainfall-runoff are different than the maximum water depths occurring from riverine flooding. The flood as a result of rainfall-runoff happens directly after the precipitation, while for riverine flooding it takes one to three hours after the precipitation when the maximum water depth is reached.

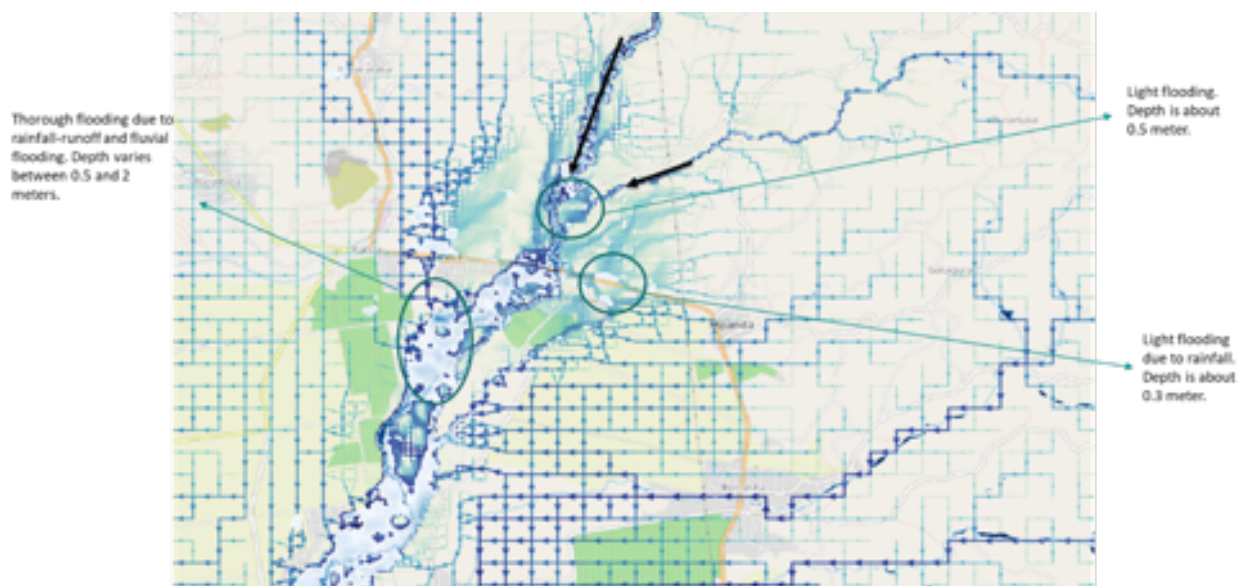


Figure 9: severity of flooding in Gahwazi II

The flood extents and vulnerable areas in Gahwazi II coincide with low-lying elevations. Figure 10 shows the cross-section of three locations along the Mpanda river within Gahwazi II. As can be seen from the Figure, locations in the cross-sections close to the river have a much lower elevation than their surroundings. This lower elevation is a result of the migration of the river over time. At locations where the river is or has been present, the elevation is lower due to river bed erosion. Since the river is still active it is expected it will change its course over the years. Furthermore, Figure 10 shows higher elevations on the Eastern side, compared to the elevations on the Western side.

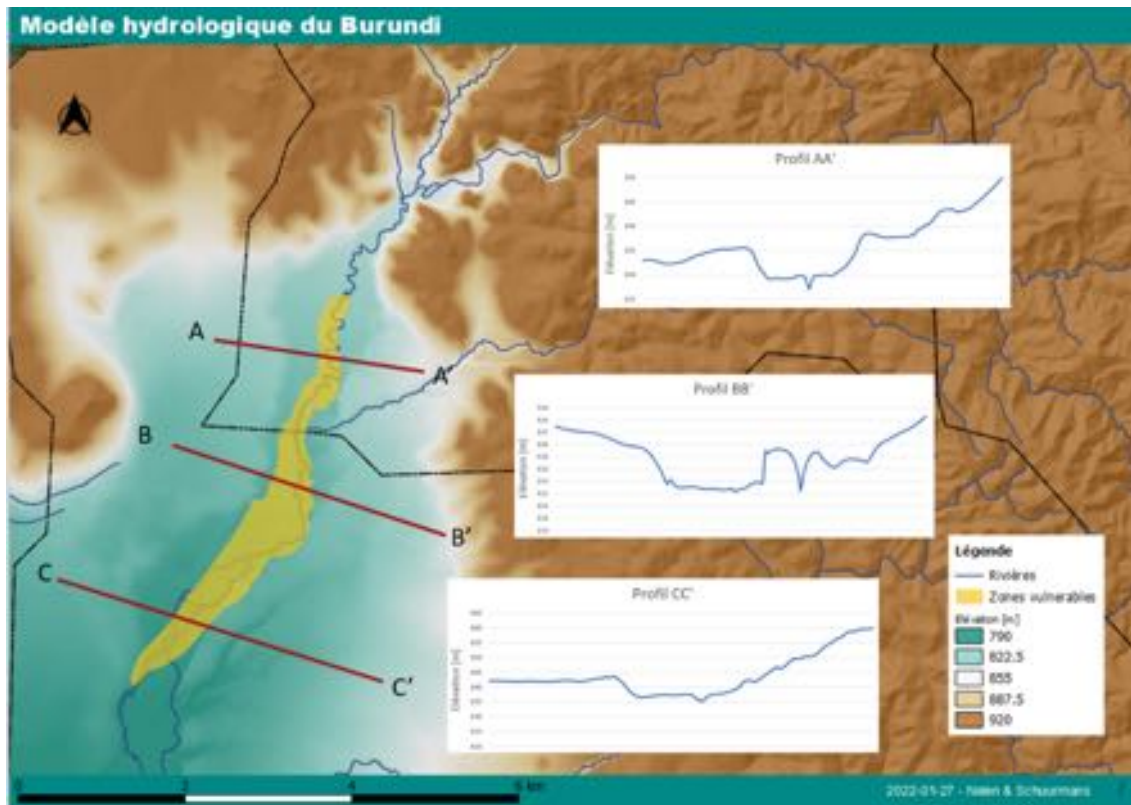


Figure 10: Cross-section at three locations in Gahwazi II. Locations in (former) river beds have lower elevations compared to its surroundings.

Rubira

The floods in Rubira originate from both the Mpanda river on the Western side, another main stream on the Eastern side and rainfall-runoff, see Figure 11. At the highest discharge of the Mpanda river, the river overflows and continues its way through Rubira, see light white lines in Figure 11.

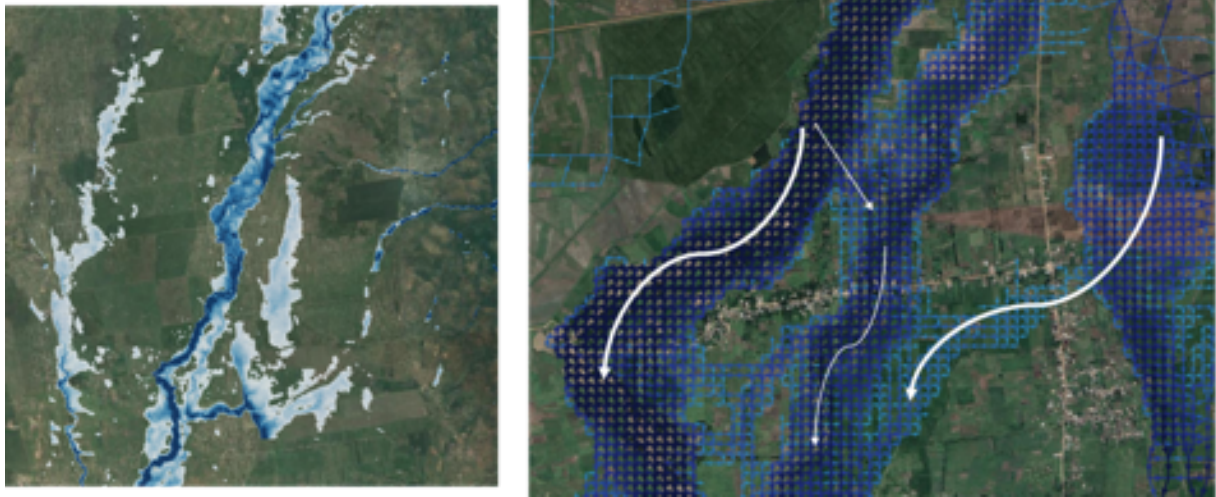


Figure 11: Water depths (left) and functioning (right) of the water system in Rubira. The thick white line on the West in the right-hand Figure depicts the Mpanda river. The thick white line on the East in the right-hand Figure depicts a main stream in the area.

The flooding in Rubira is less extreme than flooding in Gahwazi II, leading to lower maximum water depths in the area. The main sources of flooding in Rubira are direct rainfall-runoff and riverine flooding from the Mpanda river. The two light-flooded locations on the East in Figure 12 show flooding with water depths up to 0.3 m. The location on the West, close to the Mpanda river, shows severe riverine flooding with water depths up to 1.5 m.



Figure 12: Severity of flooding in Rubira

The flood extents in Rubira coincide with low-lying elevations on the Eastern part of the area. Figure 13 shows the cross-section of two locations along the Mpanda river within Rubira. As can be seen from the Figure, locations in the cross-sections on the Eastern side of the river have a lower elevation than the locations on the Western side of the river. As a result, the locations in the Western side of the Mpanda river are flooded more severe.

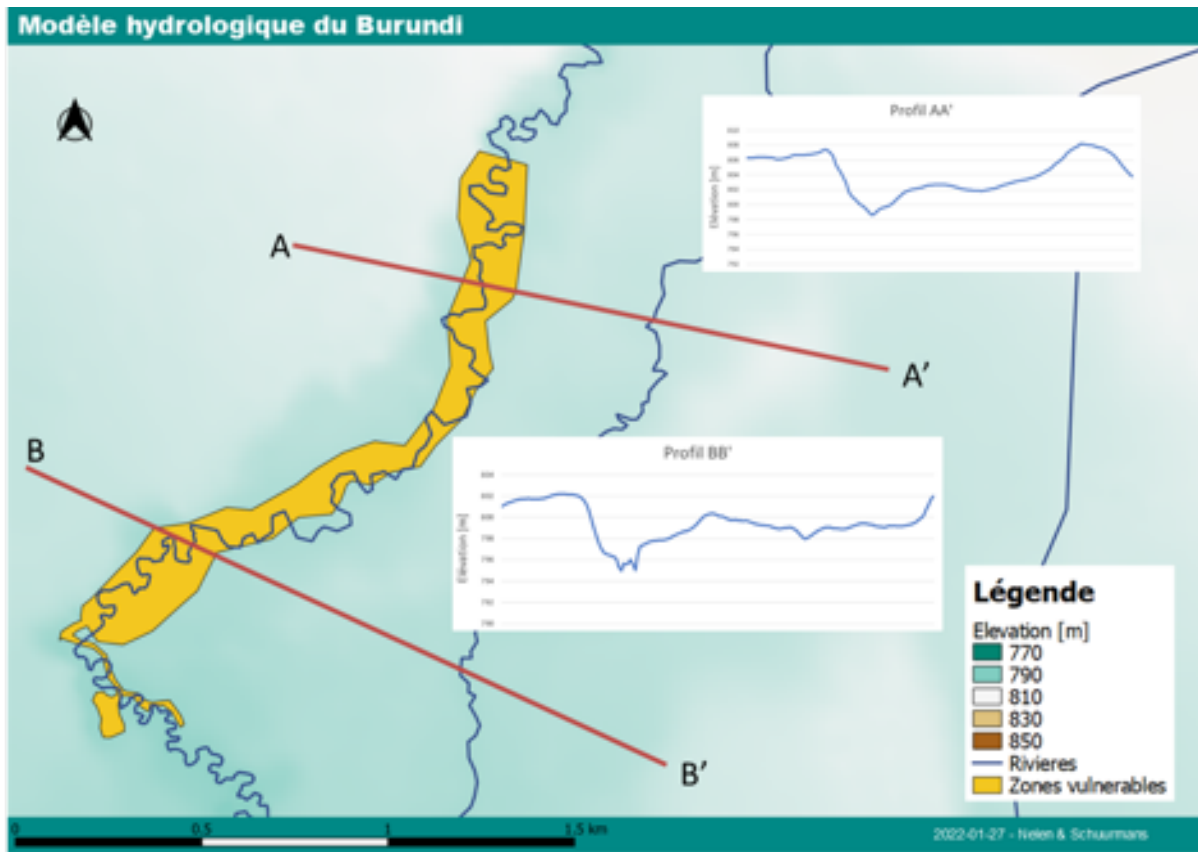


Figure 13: Cross-section at two locations in Rubira.

Selection of the SLAMDAM pilot area



Figure 14: Possible locations in Gahwazi

Conclusion risk assessment

For the risk assessment, expert knowledge, field visit, and hydrodynamic modelling together contributed to understanding the flood and drought risk in Bubanza. It can be concluded that locations along the Mpanda river are facing flood risk, during the rainy season from the end of March until May. As a result of high discharges in the Mpanda river and its tributaries, these rivers outburst their banks. High flow velocities directly result in erosion of fertile soil of agricultural areas. During the harvesting season, prolonged presence of water results in yield losses. These losses are worse for seasonal crops, like rice, sweet potato, beans, soybeans, corn, tomatoes compared to perennial crops, like oil palms and bananas.

Regarding the drought challenges in Bubanza, not much deviation is seen between the crops and locations suffering from drought. The majority of farmers do not have the opportunity in terms of available equipment to irrigate their land. Therefore, during the dry season in August and September, there is no harvest and the numbers of harvests are limited to two times a year. In case of irrigation, this number can rise to three times a year.

Furthermore, the advantages of irrigation are becoming more significant as a result of climate change. On the one hand, as a result of climate change the drought becomes more severe. On the other hand, however, precipitation is becoming more unpredictable and more extreme as a result of climate change. To cope with the flood risks, farmers try to harvest before the floods. To complete the entire growth cycle, they are constrained to plant during dry season, although no irrigation can be applied.

Conclusion location decision

Concluding from the flood and drought risk assessment, location Gahwazi2- right is chosen as the most suitable location to deploy the SLAMDAM. At this location the expected benefits from desk research and field visits are the highest as also listed in the decision matrix. Although, it's recommended to extend this analysis with observation in case of flooding. Furthermore, it is recommended to elaborate on the monitoring and evaluation plan during a flood to iteratively find the best suitable location at Gahwazi2- right.



**MINISTRE DE L'ENVIRONNEMENT,
DE L'AGRICULTURE ET DE L'ELEVAGE**

**Office Burundais pour la Protection de
l'Environnement**

N. Réf. : 003/2022/AND/FA/BDI

Letter of Endorsement by Government

To: The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email : Secretariat@Adaptation-Fund.org
Fax : 202 522 3240/5

Subject: Endorsement for the National Project « **Strengthening flood and drought resilience for communities including farmers and pastoralists in Burundi** »

In my capacity as designated authority for the Adaptation Fund in **Burundi**, I confirm that the above national grant proposal is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in the western region of Burundi.

Accordingly, I am pleased to endorse the above grant proposal with support from the Adaptation Fund. If approved, the project will be implemented by the **United Nations Environment Programme (UNEP)** and executed by **Office Burundais pour la Protection de l'Environnement (OBPE)**.

Sincerely,

Liévin NDAYIZEYE

**National Designated Authority
for the Adaptation Fund**



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