CCRA Track 1 Report: Mayana

Mayana Community Climate Vulnerability Reduction Project

February 2016

Disclaimer

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Introduction

The Climate Resilient Infrastructure Development Facility (CRIDF) is DFID's innovative water infrastructure programme for southern Africa. CRIDF prepares small-scale water infrastructure projects and facilitates access to finance for the implementation of these projects. Activities are selected according to a set of CRIDF principles to ensure that investments align with strategic objectives that have been developed specifically for each SADC river basin.

According to the CRIDF Climate Resilience Strategy, climate resilience should be practically integrated into all CRIDF Projects, at Programme, Project and Activity levels. The definition of resilience used by CRIDF is:

"*CRIDF will prepare infrastructure projects, leverage finance and/or engage with stakeholders at regional, national, sub-national or local (community) levels that better enable the most vulnerable people, to predict, manage, and/or adapt to the impacts of climate related events and climate variability (droughts, floods, and ecological and social behaviors). This may include both adaptation and/or mitigation options."*

The key questions that this report aims to answer are:

- Have we identified the possible risks and climate change poses to the project and local communities and associated response measures?
- Have we identified and documented in a systematic way the resilience benefits that CRIDF activities bring to project recipients?

The report is structured as follows:

Sections 1 and 2 present an overview of the project, the local context and vulnerability indicators information that help the reader understand the existing risk situation in the area.

Section 3 summarises an overview of projections of the estimated change in the regional and local climate for climate parameters of interest.

Section 4 provides the results from the review and the climate risk screening workshop exercise. The section includes a summary of the risks and benefits with their potential consequences for the project and local community. It also includes response measures for any identified 'high' and 'extreme' risks along with a summary of recommendations.

CRIDF

1. Project and area background

This section presents an overview of the project, the local context and historical climate and impact information that help the reader with understanding the existing risk situation in the area.

Project Background

The project's objective is enhancing the livelihoods of those who live in the area of the Kavango Zambezi Trans Frontier Conservation Area (KAZA TFCA), with particular emphasis on those most directly affected by wildlife. In some areas, KAZA is working to facilitate biodiversity conservation through the enhancement of wildlife movements in dispersal zones between protected areas in the various countries. Those living in or near these areas are often badly affected by wild animals attacking people, eating their crops and killing their livestock. Some, including a number of communities in the Zambezi Region of Namibia, prefer to adjust their residence and land use patterns to reduce their proximity to the wildlife areas and cut their crop and livestock losses. KAZA wishes to support these adjustments, where possible and appropriate. Part of the hardship that many KAZA residents face is lack of water for domestic and livestock use. People and their livestock must often travel great distances to obtain water, especially in the dry season. If they adjust their residence patterns to move away from wildlife dispersal areas, they must find new, permanent water sources.

Scope of Review

The scope of this review includes the following project components and outcomes.

Climate risk screening on the following project components:

- Jetty end structure
- River Pump Station (RPS)
- Pipeline Distribution Network
- Irrigation Fields
- Irrigation equipment
- Farm Buildings

Identification of resilience benefits of the following project outcomes:

- Relocation of farming activities and development of smallholder irrigated plots
- Access to markets
- Capacity building

2. Climate vulnerability mapping

All projects supported by CRIDF are required by the funding agency to include dimensions of climate resilience. As part of the programme's inception phase, a climate change vulnerability assessment tool was developed, to help prioritise investment in projects that best align to the CRIDF mandate. A bespoke rapid climate vulnerability assessment tool can inform CRIDFs approach to undertaking Track 1 climate risk and resilience screenings.[1]

Climate Vulnerability Tool Indicators

Table 1 below presents the level of the climate vulnerability indicators for the project area according to the climate vulnerability assessment tool. For some indicators a range is presented, which reflects the differences in vulnerability amongst sites. Further guidance on what the indicators mean is presented in Annex A.

Table 1 **Climate vulnerability indicators**

Indicator	Outcome
Future risks to people	4. Moderate
Water risk under climate change	5. High
Climate change pressure	5. Very high
Baseline risks to people	3. Medium – 2. Low
Resilient population	2. Low
Population density	0.0 - 17.0 (people per km2)
Household and community resilience Groundwater stress	0.68 More resilient
Groundwater stress	1. Low (<1)
Upstream storage	No major reservoirs
Drought severity	3. Medium to high (30-40) - 4. High (40-50)
Flood FREQ MINM	0.94736844 0.95 Low
Seasonal variability	4. High (1.0-1.33)
Inter-annual variability	4. High (0.75-1.0)
Baseline Water Stress	1. Low (<10%)
CRIDF Basin	ZAMBEZI

[1] The CRIDF Climate Vulnerability Assessment is available online at: http://geoservergisweb2.hrwallingford.co.uk/CRIDF/CCVmap.htm

Inter-annual Variability, Seasonal Variability and Flood Occurrence indicators range from High to Medium-to-High in the area according to the tool. The development of the small-scale irrigated community gardens scheme, which will be relocated off the flood plain, will improve livelihoods with inferred flood protection and drought resilience (via irrigation) for the community and reduce these risks.

3. Climate projections

This section presents on overview of the latest climate trends and projections that were used to inform the climate change scenarios developed for the project area. This Track 1 review makes use of CRIDF's regional projections and impact table to understand what how the future climate change might impact the project.

Figure 1 **Climatic Zones in SADC**

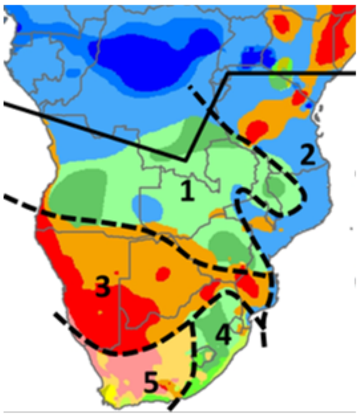


Figure 1: Climatic Zones in SADC

- **Region 1, Summer ITCZ (Intertropical Convergence Zone) region**. Angola, Zambia, and Malawi, central and NE Zimbabwe - This is a temperate/tropical region with dry winters (subtropical high pressure cells) and rainy summers (tropical lows driven by seasonal migration of the ITCZ).
- **Region 2, Summer Indian Ocean cyclone/monsoon zone.** Mozambique, Tanzania - Tropical/seasonal monsoon climate characterized by incoming cyclones from the Indian Ocean.
- **Region 3, Arid descending arm of Hadley cell.** Namibia, Botswana, SW Zimbabwe, S Mozambique - This region has a negative hydrological balance, low and variable precipitation and seasonally high temperatures.
- **Region 4, Temperate cyclonic zone**. E South Africa, Swaziland, and Lesotho - This region has a wet summer regime with thunderstorms and subtropical cyclones.
- **Region 5, Semi arid/winter rainfall zone.** W South Africa - This region is characterized by a steppe climate inland with winter rainfall and fog at the coast.

Climate Trends Overview

The project falls under region 3 and the following impacts presented in **Table 2** have been identified

Table 2 **Climate projections for project area**

Parameter	Impact by 2025	Impact by 2055
Precipitation variability	Continuing aridity of desert and semiarid environments. For planning purposes, it is best to work on decreased annual rainfall, especially to the west, with any decrease perhaps reaching 20% in parts; increases are unlikely in the west but may reach 10% in the east.	Continuing aridity of desert and semiarid environments; increased wind erosion, migration of sand dunes, decreased air quality and pollution, health effects, due to land surface aridity; episodic thunderstorms may result in soil erosion, flooding, especially in coastal areas; increased borehole extraction will result in decreased groundwater table, some ephemeral rivers will become permanently dry, perennial rivers may become ephemeral. Groundwater recharge will be reduced under all scenarios. For planning purposes, it is best to work on decreased annual rainfall, especially to the west, with any decrease perhaps reaching 20%, or even 30%, in parts; increases are unlikely in the west but may reach 10% in the east. Water supply will decrease under all future scenarios.
Temperature variability	Continuing trend of increased MAAT. Likely increase of MAAT by 0.5^{o}C to 2.0°C, but lower/higher values cannot be excluded; some increase in length of warm/drought spells and reduced frequency of cold periods.	Continuing trend of increased MAAT, heatwaves inland, increased thunderstorm activity. Likely increase of MAAT by 0.5^{o}C to 4.0°C, but lower/higher values cannot be excluded; almost certain increase in length and severity of warm/drought spells and reduced frequency of cold periods.
Extreme events	Increased frequency of drought and heatwave events.	Increased frequency and magnitude of drought events and soil moisture anomalies, which will have significant impacts on agricultural systems and sustainability.
Agriculture	Food insecurity arising from climatic instability	Increased aridity may result in increased food insecurity, spread of invasive plant and insect species, locusts, loss of rainfed agriculture and subsistence agricultural systems become less viable, decreased food production in some areas
Health	Health effects mainly as a result of short term problems with food production due to climatic variability	Health and nutrition effects, mainly as a result of longer term decreases in food production due to increased aridity, deflation of dry soils from the land surface, episodic soil erosion; food and water insecurity will increase, may be health impacts of increased pests and diseases; health impacts due to decreased water and air quality. Decreased surface water availability results in increased health and sanitation risk.

4. Review results

Following the review of the vulnerability indicators for the area and the climate trends, a meeting with the PM followed by a workshop attended by key internal project stakeholders was held to identify at a high level climate risks and resilience benefits of the project. The key individuals that were involved and informed this process and its outcomes are presented in the Table below.

Table 3 **Key people informing the CCRA results**

Name	Role
Caroline Brown	Project Manager
Richard Gillett	Project Director
Bruce Mead	Ex-Project Director

Details on the results of this process are provided in the following two sections.

Climate Risks

The project comprises of a number of physical components, that were identified and screened at a high level against a series of relevant climatic threats for the area such as flooding, drought, cyclones (where applicable), sea level rise (where applicable) etc. An overview of the project's components along with the threats that the team screened the project against are presented in the following Table.

Table 4 **Project components and climate threats**

Project component	Climatic threats
• Jetty end structure • River Pump Station (RPS) • Pipeline Distribution Network • Irrigation Fields • Irrigation equipment • Farm Buildings	• **Flood**: There is small flood risk in the area, likely to intensify with climate change • **Drought**: Drought is an issue in the area and is likely to intensify with climate change • **Fire**: Prolonged drought and higher temperatures due to climate change will make fires more likely

A summary of the outcomes of the process is presented in the following table along with a series of risk management options.

Table 5 **Climate Risk Matrix**

Project component	Flood	Drought	Fire	Risk mitigation options
Jetty end structure	**Medium**: Structure is in the mainstream of the river that might go under every few years with potential damage from debris	**Low**: Low sensitivity / no structural impacts	**No/Low risk**: Low exposure - Very little biomass in area	**Flood**: Evaluate the costs versus benefits of raising structure 1 or 2m.
River Pump Station (RPS)	**High**: Equipment is likely to be under water every few years with potential damages	**Low**: Low sensitivity / no structural impacts	**No/Low risk**: Low exposure - Very little biomass in area	**Flood**: Look at design to ensure electrical & mechanical components are suitable for such water levels e.g. floating jetty platform, submersible or removable pumps
Pipeline Distribution Network	**Low**: Low exposure / Topography minimises risk from flooding at area, pipeline to be buried	**Low**: Low sensitivity / no structural impacts	**No/Low risk**: Low exposure - Very little biomass in area	

Irrigation Fields	**Low**: Low exposure / location well above lowest point in area	**Medium**: There is some risk associated with peak demand coinciding with the lower flow of the river particularly around regulatory framework around water abstraction	**No/Low risk:** Low exposure - Very little biomass in area	**Drought**: Explore whether such drought risks have manifested in the past. Look at precipitation projections in the area. Also understand whether regulatory framework around water abstraction was enforced. Finally explore options for seasonal forecasting.
Irrigation equipment	**Low**: Low exposure / location well above lowest point in area	**Low**: Low sensitivity / no structural impacts	**No/Low risk:** Low exposure - Very little biomass in area	
Farm Buildings	**Low**: Low exposure / location well above lowest point in area	**Low**: Low sensitivity / no structural impacts	**No/Low risk:** Low exposure - Very little biomass in area	

Resilience benefits

The project delivers a series of outcomes that enhance the resilience of project recipients to climate change. An overview of the project's outcomes along with a list of resilience benefits that the project delivers are presented in the following Table.

Table 6 **Project outcomes and resilience benefits**

Project outcomes	Resilience benefits
• Relocation of farming activities and development of smallholder irrigated plots • Access to markets • Capacity building	• Livelihoods • Safety • Health • Governance • Gender • Education

A summary of the outcomes of the process is presented in the following table.

Table 7 **Climate Resilience Benefits Matrix**

Project outcomes	Livelihoods	Safety	Health	Governance	Gender	Education	Environment
Relocation of farming activities and development of smallholder irrigated plots	**High**: Increasing livelihood options by developing non-livestock agriculture and higher value crops with an assured production and increase in livestock ownership	**Medium**: slightly less risk from crocodiles	Not Applicable	Not Applicable	**High**: Much more likely for women to get engaged in smallholder plots therefore increased opportunities	Not applicable	Not applicable
Access to markets	**High**: Higher value crops with an assured production and increase in livestock ownership	Not applicable	**Medium**: Access to markets enables people to afford medicine	Not Applicable	**High**: Much more likely for women to get engaged in market activities and earn money	**Medium**: Access to markets enables people to earn money and send kids to school	Not applicable

Capacity building	**Medium**: Empowers local community to understand O&M considerations and own projects	Not applicable	Not applicable	**Medium**: Water point committee established that is community led and addresses roles and responsibilities	Not applicable	Not applicable	Not applicable

Recommendations and Next Steps

The Track 1 CCRA identified a number of risks in relation to the associated infrastructure and risk mitigating actions to be taken by the project team. The project director is responsible for ensuring that the actions below are implemented.

Flood

There is small flood risk in the area but it is likely to intensify with climate change which gives rise to the following risks:

- Jetty end structure: The structure is in the mainstream of the river and risk exists that it might go under every few years with potential damage from debris
- Similarly, the River Pump Station (RPS) equipment is likely to be under water every few years with potential damages

Actions and Next Steps

- The project engineer to evaluate the costs versus benefits of raising structure 1 or 2m.
- Project team to look at design to ensure electrical & mechanical components are suitable for such water levels e.g. floating jetty platform, submersible or removable pumps

Drought

Drought is a known and recurrent issue in the area and is likely to intensify with climate change which gives rise to the following risks:

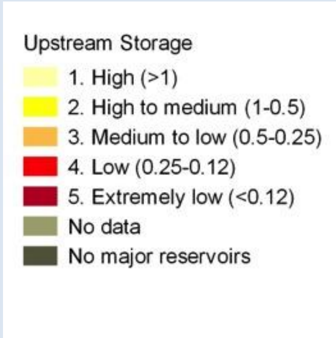
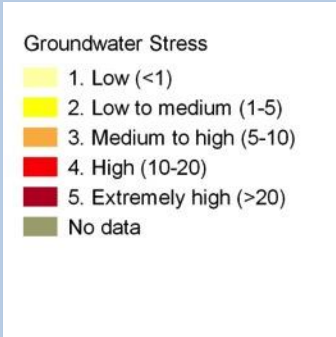
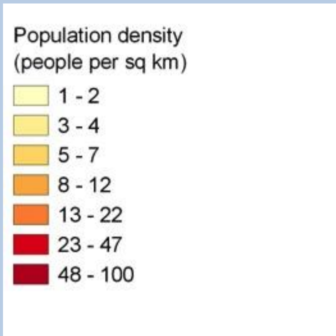
- There is some risk associated with peak demand coinciding with the lower flow of the river particularly around regulatory framework around water abstraction

Actions and Next Steps

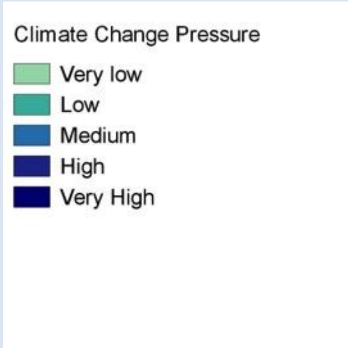
- Project team to explore with local stakeholders whether drought has been manifested in the past to an extent that will give rise to the drought risks identified above.
- Look at specific climate change precipitation projections for the area and explore what they could mean for river flows and the project
- Explore whether regulatory framework on water abstraction was enforced in the past.
- Explore options for seasonal forecasting.

Annex A: CRIDF Climate Vulnerability Tool Risk Indicators

Risk indicator	Comments	
Baseline Water Stress	This indicator is based on WRI's Aqueduct 2.0 dataset and measures total annual water withdrawals (municipal, industrial, and agricultural) expressed as a percent of the total annual available flow. Higher values indicate more competition among users. It provides an overview of the water stress situation at a country or area in cases where the dataset underpinning the stress level has enough granularity.	Baseline Water Stress 1. Low (<10%) 2. Low to medium (10-20%) 3. Medium to high (20-40%) 4. High (40-80%) 5. Extremely high (>80%) Arid & low water use No data
Inter-annual variability	This indicator is based on WRI's Aqueduct 2.0 dataset and measures the variation in water supply between years. This indicator is useful for understanding risks particularly to agriculture. High inter-annual variability creates difficulties in managing water resources in low water availability periods and can create stresses to ecosystems.	Interannual Variability 1. Low (<0.25) 2. Low to medium (0.25-0.5) 3. Medium to high (0.5-0.75) 4. High (0.75-1.0) 5. Extremely high (>1.0) No data
Seasonal variability	This indicator is based on WRI's Aqueduct 2.0 dataset and measures variation in water supply between months of the year. The higher this indicator the less reliable water supply can be expected during any given a year. High seasonal variability can have negative implications for steady water supply for households and year round agriculture particularly when rain-fed. This indicator can be helpful to characterise drought risks for rain-fed agriculture.	Seasonal Variability 1. Low (<0.33) 2. Low to medium (0.33-0.66) 3. Medium to high (0.66-1.0) 4. High (1.0-1.33) 5. Extremely high (>1.33) No data
Drought severity	This indicator is based on WRI's Aqueduct 2.0 dataset and measures drought severity calculated as the average length of droughts times the dryness of the droughts. It includes data from 1901 to 2008. This indicator can be taken into account to characterise drought risk in an area.	Drought Severity 1. Low (<20) 2. Low to medium (20-30) 3. Medium to high (30-40) 4. High (40-50) 5. Extremely high (>50) No data

Upstream storage	This indicator is based on WRI's Aqueduct 2.0 dataset and measures the water storage capacity available upstream of a location relative to the total water supply at that location. Higher values indicate areas more capable of buffering variations in water supply (i.e. droughts and floods) because they have more water storage capacity upstream.	
Groundwater stress	This indicator is based on WRI's Aqueduct 2.0 dataset and measures the ratio of groundwater withdrawal relative to its recharge rate over a given aquifer. Higher values indicate areas where unsustainable groundwater consumption could affect groundwater availability and groundwater-dependent ecosystems. This indicator can be taken into account to characterise water availability risk at an area that is mainly dependent for groundwater for its water supply needs.	
Household and community resilience	This indicator is based on the Climate security vulnerability model by the Robert S. Strauss Centre and combines data on physical, socio-economic, demographic, and political insecurities to provide an indication on household and community vulnerability to climate change. It can be taken into account when characterising impacts to local communities. The lower the resiliency the higher the consequence can be expected for any given impact. Most resilient communities can withstand a 20% crop loss however this can be catastrophic for the least resilient	
Population density	This Population density index is based on the Climate security vulnerability model by the Robert S. Strauss Centre. This indicator can be taken into account when trying to understand H&S impacts to local communities from extreme weather events.	

Resilient population	HR Wallingford has developed this indicator by combining population density, the CCAPS governance layer and the CCAPS household and community resilience layer. It can be taken into account when characterising impacts to local communities. The lower the resiliency the higher the consequence can be expected for any given impact. Highly resilient communities can withstand a 20% crop loss however this can be catastrophic for the least resilient	Resilient Population Low Medium High
Baseline risks to people	HR Wallingford has developed this indicator by combining the resilient population layer and the AQUEDUCT physical water quantity risk.	Baseline Risk to People Very low Low Medium High Very High
Future risks to people	HR Wallingford has developed this indicator by combining the baseline risks to people layer, the climate change pressure layer and the physical water risk layer.	Future Risk to People Very low Low Moderately Low Moderate Moderately high High Very High
Water risk under climate change	HR Wallingford has developed this indicator by combining the climate change pressure layer and the physical water risk layer.	Water Risk Under Climate Change Low Medium High

Climate change pressure	HR Wallingford has developed this indicator by using the average rainfall and temperatures from 2006 to 2026 of the low emissions scenario (RCP 2.6) and compared this to the average rainfall and temperatures from 2080 to 2100 of the high emission scenario (RCP 8.5). To calculate a climate change pressure indicator the change in temperature was subtracted from the change in rainfall, multiplied by two. These values have been rescaled linearly to a scoring system of 1 to 5.	

CRIDF