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Climate Resilient Development Pathways Workplan Development: Climate Index Workshop Report and Presentation

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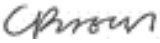
Quality Assurance Checklist

In preparing this document CRIDF can confirm that it has followed CRIDF's internal general procedures, including appropriate CRIDF generic scope of work and that it has undergone appropriate quality assurance (QA) and quality control (QC) procedures as detailed in CRIDF's QA manual. Furthermore, CRIDF can confirm the applicable specific internal process and procedures have been followed including:

- CRIDF's Cost Benefit Assessments (CBAs) guideline have been applied as appropriate;
- CRIDF's Gender Equality and Social Inclusion (GESI) guidelines have been applied as appropriate;
- CRIDF's Climate vulnerability mapping methodology has been applied as appropriate;
- CRIDF's Climate Change Risk Assessment (CCRA) protocol have been applied as appropriate;
- CRIDF's Procurement guidelines have been followed as appropriate;
- CRIDF's Screens as appropriate.

Lead Author: Bruce Mead		CRIDF QA'd: Jeremy Richardson		CRIDF QC'd: Caroline Brown Previlage Chidzewere	 	CRIDF Approved: Charles Reeve	
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Disclaimer

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List of Acronyms

Acronym	Long-Form
CRDP	Climate Resilient Development Pathways
CRIDF	Climate Resilient Infrastructure Development Facility
DFID	Department for International Development
ITCZ	Intertropical Convergence Zone
MSIOA	Multi Sector Investment Opportunity Analysis
OBSC	Okavango Basin Steering Committee
OKACOM	The Permanent Okavango River Basin Water Commission
OKASEC	OKACOM Secretariat
RCP	Representative Concentration Pathway
SADC	Southern African Development Community

Introduction

CRIDF offered to support the MSIOA process to develop a 'climate vulnerability index' within the OKACOM Options Analysis Phase of their planned Sustainable and Equitable Climate Resilient Investment Programme. This was presented to OKACOM as per Annex 1 – a PowerPoint showing the outline of the concept.

This was incorporated within the CRDP work plan, where the application of the climate index within the MSIOA, was pitched as an operational 'pilot' to inform the wider CRDP processes.

In the build up to the 33rd OKACOM OBSC meeting, held in Gaborone on the 30th November 2016, CRIDF secured the inputs of Professor Jasper Knight from Wits University in order to prepare the first draft of an operational instrument that could be applied to the MSIOA development scenarios to aid decisions on the choice of appropriate development trajectories. This input was used to prepare a presentation (see Annex 2), delivered to the workshop as part of the MSIOA programme, to both demonstrate its application and to solicit feedback from Basin professionals in OKACOM and from the Member States.

The presentation was delivered, the discussions held, and the learning from this process is incorporated in this report. The format for the report is as follows:

- Introduction
- Current Climate and Likely Trends
    a. Summary of present climate in the Basin
    b. Presentation of selected results from a range of published reports
    c. Summary of likely climate changes
- Development Scenarios and Concepts
    a. Discussion on selected MSIOA scenarios
    b. Discussion on resilience concepts
- Commentary on likely impacts
- Assessment of impacts, per scenario, split into 'likelihood' (that the impact occurs) and 'severity' (of the impact, should it occur).
- Discussion on the presentation and discussions
- Conclusions and recommendations

Current Climate and Likely Trends

Present climate

The CRIDF Projections and Impacts Paper [Online: http://www.cridf.com/ccra] splits the basin into two main climatic regions – the headwater areas in southern Angola, with higher elevation areas, orographic rainfall, a high river drainage density, falling within the Inter Tropical Convergence Zone ITCZ which is a summer rainfall zone with dry winters.

The rest of the basin lies within the arid climate zone of the descending arm of Hadley cell, with low and variable precipitation, high temperatures, and a negative water balance. This covers the part of the basin in Namibia and Botswana.

Future climate trends

Three published papers were used to illustrate the range of climate scenarios at a series of points in the next eighty years (the full references are provided in a section below):

Li et al. 2015, Journal of Hydrology

Temperatures to 2029: increased winter temperature by 0.2-0.6^{o}C relative to 1990 values, increased summer temperature by 0.4-1.0^{o}C relative to 1990 values. Greater increase in Angola than Namibia or Botswana, especially in summer. Net annual increase of 0.4-0.8^{o}C

Precipitation to 2029: no change in winter precipitation, decreased summer precipitation over Angola by -10 to -20%, increased summer precipitation over Botswana by +5%

These changes correspond to a decrease in runoff by -25% in Angola and Namibia, and increase in runoff by +50->75% in Botswana (but from a low base)

Niang et al. IPCC AR5 2014

Recent trends: Temperature increased by +0.5-1.5^{o}C over period 1901-2012, decreased precipitation by -5 to -10 mm/yr/decade over period 1951-2010

Future trends: By mid-century, increased temperature by +1/5^{o}C (RCP2.6), +2.5^{o}C (RCP8.5), decreased precipitation by -10% under both RCP scenarios

By 2100, increased temperature by +1/5^{o}C (RCP2.6), +>4.0^{o}C (RCP8.5), decreased precipitation by -10% (RCP2.6), -20% (RCP8.5) (strong agreement)

Dike et al. 2015, International Journal of Climatology

Using different RCPs for the period 2073-2098, summer and winter temperature increases of 1-2^{o}C (RCP2.6) to 5-6^{o}C (winter, RCP8.5) and 5-7^{o}C (summer, RCP8.5)

For the same period, precipitation changes of: -0.2 to -0.5 mm/day for Angola and Namibia, and +0.5-1.0 mm/day for northern Botswana (summer, RCP2.6), to no change (winter, RCP2.6). For RCP8.5, decrease in precipitation of -0.2 to -0.5 mm/day across the region (summer), to no change (winter).

Summary of future climate trends

These future climate projections suggest increased temperature and decreased precipitation. Spatial differences are not well resolved, but variations in the position and dynamics of the ITCZ summer rains is critical. Climate models do not reproduce the dynamics of the ITCZ precipitation very well, and this uncertainty may be amplified by orographic and convective patterns over southern Angola headwater areas. Under higher RCP values, the position of the ITCZ may extend farther south, suggesting greater seasonality at the southward extent of the ITCZ when compared to present, with seasonal migration over a greater distance thus greater atmospheric instability. Winters, which are already dry, exhibit least change whereas the wetter summers are more variable. Northern parts of Botswana are likely to be somewhat wetter, linked to penetration of Indian Ocean cyclones. Namibia in particular undergoes greater summer aridity, which is likely linked with decreased upwelling of the Benguela Current.

Development Scenarios and Concepts

Different development scenarios chosen

Development scenarios are based on water demand, not water availability, which means that the sustainability of these development scenarios is debatable. The scenarios LS01, LS05/06 and LS08 are chosen here, because these represent the range of development scenarios presented (this does not mean that each development scenario has an equal likelihood of implementation or of sustainability). These are summarized in Table 1.

Table 1 : Summary of MSIOA scenarios from different perspectives. L = low, M= medium, H= high values

	Angola				**Botswana**				**Namibia**				**Basin**			
	NPV	**SJ**	**EI**	**CR**	**NPV**	**SJ**	**EI**	**CR**	**NPV**	**SJ**	**EI**	**CR**	**NPV**	**SJ**	**EI**	**CR**
LS01	L	L	-		M	H	-		L	M	-		L	L	-	
LS5/6	H	M/H	M		L	M	M		L	M	M		M	M/H	M	
LS8	H	H	L		L	L	L		H	H	L		H	H	L	

In detail, the three development scenarios correspond to different river/water management activities, focusing on water abstraction leading to irrigation, and dam development. High irrigation and water abstraction under conditions of future climate change are likely to lead to the following effects:

- High evaporation, salinization of surface soils
- Reduced groundwater table, reducing potable water availability and increasing the cost/effort of water abstraction especially in rural areas or with dug wells
- Decreased vegetation cover, increased likelihood of wind and water erosion, land degradation
- Increased surface water temperatures and salinity, with implications for ecosystems and biodiversity, fisheries/aquaculture, hydropower production
- Decreased water quality, with implications for risk of waterborne diseases
- Marginalization of smallholder/subsistence farmers at the expense of richer commercial farming

Resilience Concepts

Climate resilience as a concept is not well founded, because there are no clearly established or agreed methodologies for its calculation, the concept varies depending on the climatic, political and socioeconomic context under consideration, and it involves a combination of aspects of the physical and human

environments. These aspects may be hard to measure using empirical data, and key datasets on human and environmental indicators may be absent. Any measure used also has high spatial and temporal variability, which is not well captured in calculations of averaged index values.

Some of the most common elements of climate resilience are included in Fig 1:

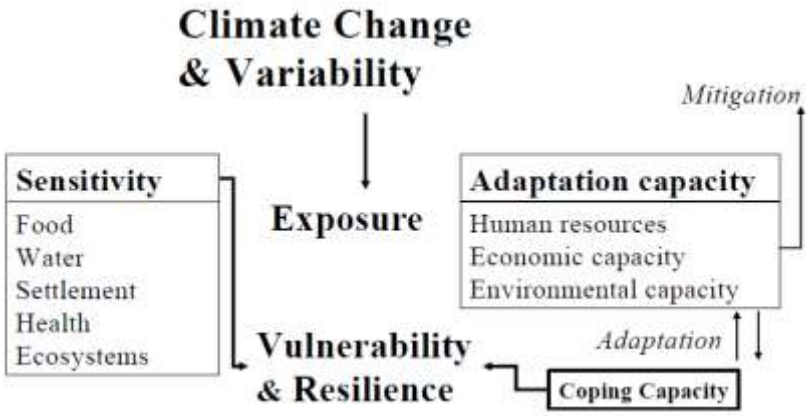

Figure 1: Flow diagram of the most common elements included in a calculation of climate resilience (Ibarraran et al. 2008).

Commentary on likely impacts

Consideration of climate resilience in the context of the Okavango River basin can be done through the two main climate regions, (1) Angola, most strongly affected by variations of the ITCZ, and (2) the arid climate of Botswana and Namibia. This is discussed with respect to approximately mid-century climate, because the development scenarios do not specify any particular timeframe.

Terminology used

High: this factor is of high significance

Medium: this factor is of medium significance

Low: this factor is of low significance

Values cited in the table are made up of two parts: first, an evaluation of the likelihood of this factor being a significant variable to consider with respect to that development scenario; second, an evaluation of the severity of impact of this factor on the sustainability of maintaining or achieving that development scenario.

Different evaluations of climate resilience as presented in Table 2 are based on considerations of water use and different crop combinations (as specified in the different development scenarios), against future climate projections with respect to temperature and precipitation changes. Generally, the higher water abstraction scenarios (LS05/06 and 08) present higher risk and higher likelihood of environmental degradation leading to issues for sustainable development. Generally, it is considered that Angola and Namibia are at higher risk than Botswana, but any evaluation of risk or vulnerability as presented in Table 2 is based solely on a consideration of future climate: political and socioeconomic considerations with respect to transboundary water use, protected areas, trade agreements etc. are likely far more significant in risk and vulnerability assessment, and may significantly amplify any negative climate change impacts.

Impacts Table

Table 2 : Evaluation of different development scenarios for the two climate regions under discussion, with respect to climate resilience

Climate Zone	Climate zone 1: ITCZ region						Climate zone 3: semiarid environment											
	Angola						Namibia						Botswana					
Scenario	LS01		LS05/06		LS08		LS01		LS05/06		LS08		LS01		LS05/06		LS08	
Likelihood (L) Severity (S)	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S
Extreme climatic events																		
Hydrological systems and processes																		
Agriculture and ecosystems																		
Health impacts of climate change																		
Environmental sustainability																		
Summary of RISK																		
Summary of VULNERABILITY																		

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- Niang, I., Ruppel, O.C., Abdrabo, M.A., Essel, A., Lennard, C., Padgham, J., Urquhart, P., 2014. Africa. In: Barros, V.R., Field, C.B., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (eds), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge/New York, pp. 1199–1265.

Workshop Proceedings and Discussion

Context and setting

The Climate Index session was held in the MSIOA workshop as an integrated part of the 'MSIOA Approach' segment. It was presented alongside the other major decision criteria - economic modelling, social modelling, hydrological modelling and environmental modelling.

The participants are as indicated in Annex 4 below. The main components of the workshop were as follows:

Session 1

- Welcome & Opening - Botswana Commissioner and OKACOM Secretariat
- Introductions & Expectations

Session 2

- MSIOA Update
- Development Program for the Cubango-Okavango
- Multi-Sector Investment Opportunity Analysis
- Benefit Assessment
- Stakeholder Assessment
- Objectives & Vision

Session 3

- MSIOA Approach
- Economic Modelling
- Hydrological Modelling
- Environmental Modelling
- Climate Resilience

Session 4

- MSIOA Modelling and Tools
- Development Space
- Investment Program Introduction
- Livelihood Program
- Tourism Investment Program
- Infrastructure Development

Session 5

- The Way Forward
- Livelihood Investment Program

- Vision & Concept
- Program Description & Activities
- Next Steps
- Tourism Investment Program
- Vision & Concept
- Program Description & Activities
- Next Steps
- Infrastructure Development Program
- Vision & Concept
- Program Description & Activities
- Next Steps

Session 6

- Enabling Factors
- Vision
- Institutions
- Financing

Session 7

- Roadmap and next steps

Presentation

The presentation is attached as Annex 2. This was presented by CRIDF, and was based on the paper prepared by Jasper Knight (as laid out above). The main sections of the presentation were:

- Climate context: Analysis of (published but not focussed) projections.
- MSIOA development scenarios, associated vulnerabilities.
- Climate impacts – the key impact areas (related to the infrastructure options in the development scenarios).
- Visualisation for scenario spread – the 'likelihood' (of the impact occurring) and the 'severity' (if it does occur).
- Beyond Okavango – CRDP at a SADC scale – CRIDF1 and follow-up under CRIDF2

It emphasised a number of key points related to the expectations for the tool including:

- The expectation of current and increasing precision vs the reality of dealing with more uncertainty.
- Proportionality – the climate signal in relation to other drivers of change.
- Discussion on the limits of science - science is good at alerting us about the problem. It is not so good at informing us what to do. We have to make the best decisions we can with the best available current information.

- No regrets and immediate action - start right now on the things that reduce vulnerable peoples' exposure to climate change – it's the only foundation on which to build any sustainable economic growth in the future.

A number of leading questions were posed in the preparation for discussion, as follows:

- Are there any other options that have not been assessed (e.g. regional tourism investment programme, rain-fed agriculture improvement in the high rainfall areas, livestock improvement, agri-processing etc.?)
- What happens to the climate vulnerability assessment if the current assumptions related to types of crops and irrigation efficiency are revised to consider high-value, water efficient crops and cutting-edge in-field irrigation systems?
- What trade-offs do these types of technology and management allow (for example could crop selection and improved water efficiency completely 'offset' the Central Areas of Namibia - CAN - abstraction?)
- Can different production options lead to i) better opportunities for social justice and inclusive economic growth, ii) added growth opportunity through agri-processing and local value addition, iii) more sustainable green growth and iv) more equitable gender outcomes?

Discussion

A lively discussion ensued, with a number of technical and conceptual questions. The participants embraced the index concept and its use (alongside other decision tools), and appreciate both the utility and the limits of the tool as a decision support aid.

The focus was on the application of the tool in decision making for the future. It was appreciated that the current MSIOA development scenarios were in fact 'the beginning' of the substantive decision making process, but that the shape of the final development scenario, and its associate infrastructure programmes, is an ongoing process.

Some suggestions on the presentation of the index were made, including aggregation of the 'scores' across the basin of the separate impacts of climate change. This will be adopted in the next iteration.

Conclusions and Observations

A number of conclusions and findings can be derived as follows:

- The exercise met the expectations of the participants and they indicated a desire to remain involved in the wider CRDP process to i) refine and nuance the OKACOM/MSIOA impacts analysis and ii) assist with feeding back to a wider SADC audience via the CRDP.
- Improvements were suggested in relation to the presentation of the index, and these will be adopted
- The participants were particularly interested in the discussion around a number of the 'leading questions' – the inclusion (for future assessment) of other options that have not been addressed in the MSIOA development, using the tool to consider 'improvements' to the investments proposed (for example, the change in vulnerability if the current assumptions related to types of crops and irrigation efficiency are revised to consider high-value, water efficient crops and cutting-edge in-field irrigation systems).
- CRIDF itself has a number of internal lessons from the process, both to feed into the CRDP process that runs to the end of March as well as to setting up a potential longer term, embedded climate assessment process within OKACOM under CRIDF2.

Annex 1: Presentation to OKACOM August 2016 – the Climate Index Concept

See pdf'ed presentation

Annex 2: Presentation to OKACOM November 2016 – first draft Index development

See pdf'ed presentation

Annex 3: Workshop Agenda

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OKACOM

Cubango-Okavango Sustainable and Equitable Investment Program
Multi-Sector Investment Opportunity Analysis
Report Validation Workshop
Wednesday, November 30, 2016
Cresta Lodge
Gaborone, Botswana

AGENDA

Wednesday, November 30, 2016		
Time	**Session**	**Responsibility**
Session One: Introduction		
08:30 – 08:45	**Welcome & Opening**	Botswana Commissioner and OKACOM Secretariat
08:45 – 09:15	**Introductions & Expectations** • Each participant will introduce themselves • 5 min expectations or reflections on MSIOA	OKACOM Secretariat (OKASec)
Session Two: MSIOA Update		
09:15 – 09:45	**Development Program for the Cubango-Okavango** • Multi-Sector Investment Opportunity Analysis • Benefit Assessment • Stakeholder Assessment • Objectives & Vision	World Bank
09:45 – 10:45	**MSIOA Approach** • Economic Modelling • Hydrological Modelling • Environmental Modelling • Climate Resilience	World Bank - ECA
10:45 – 11:00	**Tea / Coffee Break**	
11:00– 12:00	**MSIOA Modelling and Tools**	World Bank - ECA
12:00 – 12:30	**Development Space**	World Bank - ECA
12:30 – 13:00	**Investment Program Introduction** • Livelihood Program • Tourism Investment Program • Infrastructure Development	World Bank - ECA
13:00 – 14:00	**Lunch**	
14:00 – 14:10	**The Way Forward**	World Bank - ECA
14:10 – 14:30	**Livelihood Investment Program** • Vision & Concept • Program Description & Activities	World Bank - ECA

	• Next Steps	
14:30 – 14:50	**Tourism Investment Program** • Vision & Concept • Program Description & Activities • Next Steps	World Bank – ECA
14:50 – 15:10	**Infrastructure Development Program** • Vision & Concept • Program Description & Activities • Next Steps	World Bank - ECA
15:10 – 15:30	**Tea / Coffee Break**	
15:30 – 16:30	**Enabling Factors** • Vision • Institutions • Financing	World Bank / OKASec
16:30 – 17:00	**Next Steps**	OKASec / World Bank

Annex 4: Participant List MSIOA Workshop 30th November 2016

See pdf attached


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