November 2024

Strategic Environmental Assessment for the Cuando River Basin

VOLUME 3

Strategic Environmental Management and Monitoring Framework (SEMMF)

Foreword

The Cuando River Basin, shared by Angola, Botswana, Namibia, and Zambia, is a vital sub-basin of the greater Zambezi Watercourse, supporting diverse ecosystems, livelihoods, and economic activities across the region. As riparian states strive to harness the basin's potential for sustainable development, it is imperative to balance socio-economic progress with environmental stewardship.

The Strategic Environmental Assessment (SEA) of the Cuando River Basin reinforces our shared vision of fostering resilient ecosystems, securing water resources for present and future generations, and promoting transboundary collaboration. From a strategic point of view, the SEA's alignment to the Strategic Plan of the Zambezi Watercourse (ZSP 2018 – 2040) is critical in ensuring sustainable environment and water resources management. It serves as a crucial tool in ensuring that environmental, social, and economic considerations are integrated into decision-making processes.

The Zambezi Watercourse Commission (ZAMCOM) remains committed to fostering cooperation among riparian states in promoting the sustainable and equitable utilization of shared water resources. This SEA aligns with our collective vision of strengthening resilience, enhancing livelihoods, and safeguarding biodiversity in the region. It provides a science-based assessment of potential impacts, mitigating measures, and opportunities for sustainable development. Importantly, it also provides recommendations for implementation.

I commend the governments of the Republic of Angola, Republic of Botswana, Republic of Namibia, and the Republic of Zambia for their commitment to this important initiative. I also extend my gratitude to our partners, the Kavango-Zambezi Trans-frontier Conservation Area (KAZA TFCA) Secretariat for their technical support and the World Wildlife Fund (WWF), whose financial and technical support has been invaluable in making this initiative a reality.

Through enhanced collaboration, data-driven decision-making, and strategic investments, we can ensure that the Cuando River Basin remains a source of prosperity and environmental integrity for present and future generations.

On behalf of ZAMCOM, I encourage all stakeholders to actively engage with the insights provided in this assessment and to work together toward a sustainable and resilient future for the Cuando River Basin.

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ZAMCOM EXECUTIVE SECRETARY

CONTENTS

Acknowledgment

This SEMMF draws partly on the equivalent framework that was developed for the Cubango-Okavango River Basin, compiled by Nemus – Gestão e Requalificação Ambiental, Lda., for the Permanent Okavango River Basin Water Commission (OKACOM), from December 2020 to December 2021. The authors of the CORB SEA are hereby acknowledged. It was decided to keep the CORB and CURB SEMMF's as similar as possible in form, structure and content to facilitate consistent implementation by both OKACOM and ZAMCOM. This is further necessitated by the fact that most of the government agencies in the respective countries serve on both these commissions and are an integral part of the greater KAZA effort.

1. Introduction

The KAZA TFCA goal "*To sustainably manage the Kavango Zambezi ecosystem, its heritage and cultural resources based on best conservation and tourism models for the socio-economic wellbeing of the communities and other stakeholders in and around the eco-region through harmonization of policies, strategies and practices*" blends well with that of the transboundary cooperation among five KAZA partner states (and others) as part the Zambezi Watercourse Commission (ZAMCOM).

ZAMCOM's objective is "*To promote the equitable and reasonable utilization of the water resources of the Zambezi Watercourse as well as the efficient management and sustainable development thereof*".

The vision for the CURB is "**A sustainable and resilient Cuando Basin for all by 2040.**".

This vision provides a guiding principle for future developments in the basin and highlights the common integrated objective of protecting biodiversity and environmental values while improving the livelihoods and quality of life of basin communities, through sustainable economic growth and development. This can be illustrated in figure 1.

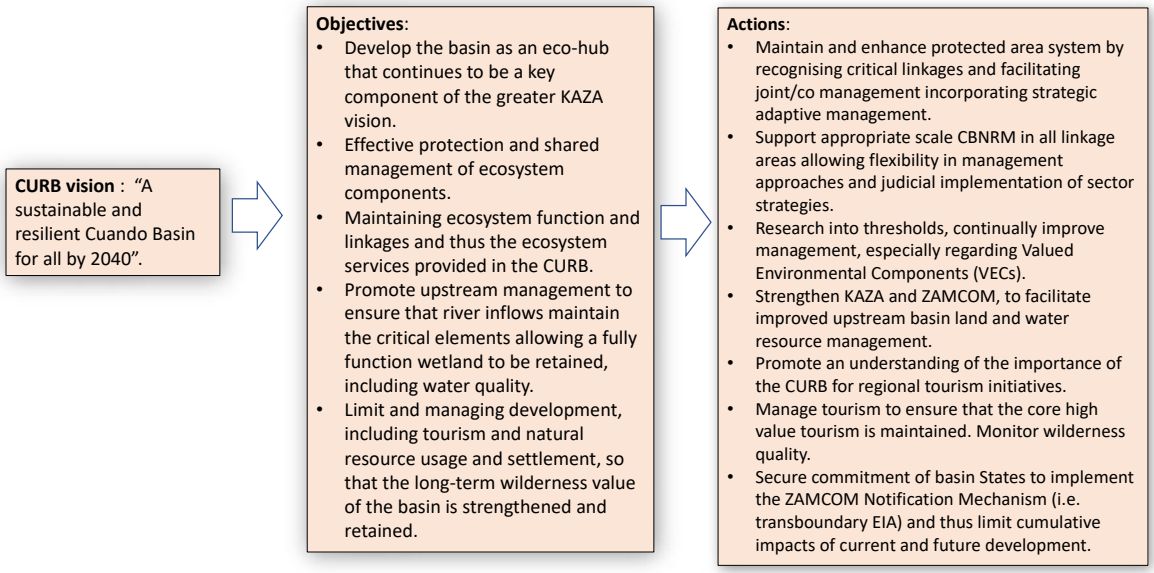

Figure 1: In a "nutshell" – the continuum from vision to actions

Notwithstanding, CURB Member-States (MSs) recognise that the lack of a comprehensive socio-economic management and monitoring programme hampers policy making and planning at the basin level.

As required by the Terms of Reference, this proposed Strategic Environmental Management and Monitoring Framework (SEMMF)[1] should be "*a tool able to flag events outside the agreed land-use plans and alert local and central governance agreements*". Thus, it aims to enable a systematic and regular basin-wide assessment of the socio-economic conditions of the CURB, taken both as drivers of change and as outcomes of developments and conservation efforts. Ultimately, the SEMMF will provide decision makers with a tool to assess socioeconomic development progresses in the basin, supporting the identification of trends, threats, opportunities, and necessary actions. Hence, it is designed to support the implementation of holistic policies and strategies that preserve the sustainable development of the CURB and ensure the achievement of ZAMCOM's shared vision for the basin.

2. Construction of the Strategic Environmental Management and Monitoring Framework

The SEMMF aims to meet the need for a regular assessment of the basin's environmental conditions, capable of supporting decision-making and planning.

The SEMMF is:

- Focused on indicators that collectively measure key trends.
- Based on sound theory and thereby clearly outline the connections between the indicators and the issues they address ('what is being measured and why'), allowing, *inter alia*, for cause-effect analysis.
- Suitable for the users' goals for basin monitoring and management.
- Accessible to users and other stakeholders.

The following sections detail the conceptual models on which SEMMF is based, and the considerations taken in the selection of specific indicators.

2.1. Conceptual foundation[2]

The SEMMF is meant to help track the environmental response to land use and development in the CURB. As a consequence, it should help promote the sustainable use of natural

[1] Whilst the ToRs use the term Socio-economic Monitoring Framework, it is deemed necessary to reword SEMMF as Strategic Environmental Management and Monitoring Framework. This is because the key issues of management concern in the Cuando Basin are biophysical, and because people's livelihoods are largely based on ecosystem services.
[2] Modified from Nemus 2022, FAO 2022

resources, the protection of the environment and the maintenance of ecosystem services that sustain people's livelihoods.

The SEMMF reflects upon on four frameworks: (i) the Drivers-Pressures-State-Impact-Response (DPSIR) analytical framework, (ii) the ecosystem services framework, (iii) the sustainable livelihoods framework, and (iv) the concept of coupled social-ecological systems (SES).

The **DPSIR Framework** provides a structure within which to present the indicators needed to enable feedback to policy makers on environmental quality and the resulting impact of the political choices made, or to be made, in the future. The DPSIR framework assumes a chain of causal links starting with 'driving forces' (economic sectors, human activities) through 'pressures' (emissions, waste) to 'states' (physical, chemical and biological) and 'impacts' on ecosystems, human health and functions, eventually leading to political 'responses' (prioritisation, target setting, indicators). Establishing a DPSIR framework for a particular setting is a complex task as all the various cause-effect relationships have to be carefully described and environmental changes can rarely be attributed to a single cause[3].

The framework can be further extended to account for the links and interrelations between the DPSIR elements. For instance, the relationship between economic activities and their resultant pressures can be seen as a function of the efficiency of the technology and production systems in use, meaning drivers can result in less pressures if eco-efficiency is improving (i.e., economic activities[4] can expand without an equivalent increase in pressure on the environment). The indicators in the SEMMF are centred on a DPSIR conceptual framework subset: the drivers and impacts, with their selection being informed by the linkages with the pressures and state.

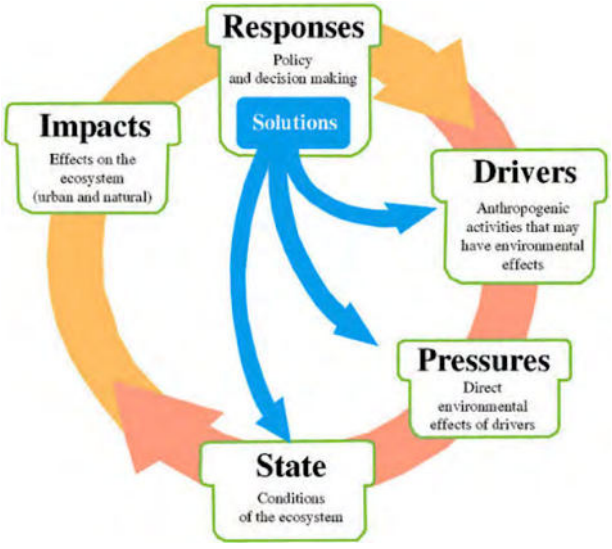

Figure 2 – Elements of DPSIR analytical framework and their linkages[5]

[3] https://www.fao.org/land-water/land/land-governance/land-resources-planning-toolbox/ category/ details/en/c/1026561/
[4] Such as conservation agriculture and eco-tourism
[5] Source: https://encyclopedia.pub/entry/1535

Concurrently, the SEMMF also considers the **ecosystem services (ES) framework**, which recognises the linkages between ecosystem change and human well-being, in particular, how changes in ecosystem services have and will affect human well-being. The ES framework highlights the benefits that society derives from nature, as illustrated below.

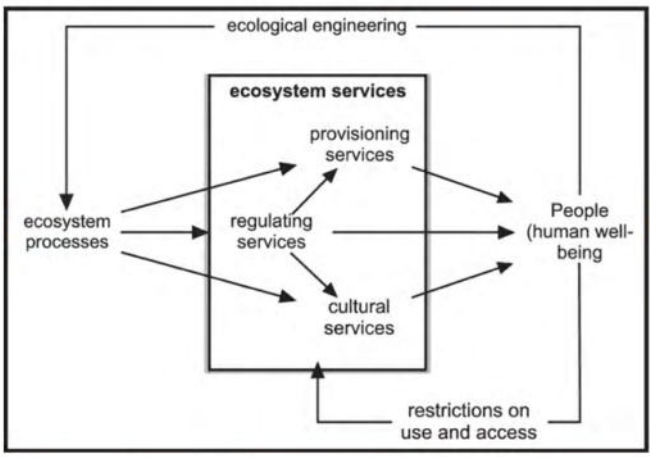

Figure 3: Diagram representing ecosystem services[6].

The ES framework focuses on ecosystems' capacity to produce goods and services. In principle, ecosystems have the ability to recover their resource losses by regenerating them over time, provided that the threshold damage limit is not exceeded. However, many ecosystems are characterized by critical thresholds, beyond which their state changes and they are no longer able to provide goods and services (Matzdorf and Meyer 2014).

Human well-being, employment and economic activities in the CURB are largely dependent on ecosystems; however, unless carefully managed, development and human activity usually reduces the capacity of ecosystems to meet future needs. The conservation and sustainable use of ecosystem services is thus vitally important for sustaining the basin's people.

The **sustainable livelihoods framework** is described as follows: "A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a living is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term." [7] It can be illustrated as follows:

[6] Source: Gupta and Nair 2012
[7] Chambers and Conway 1992

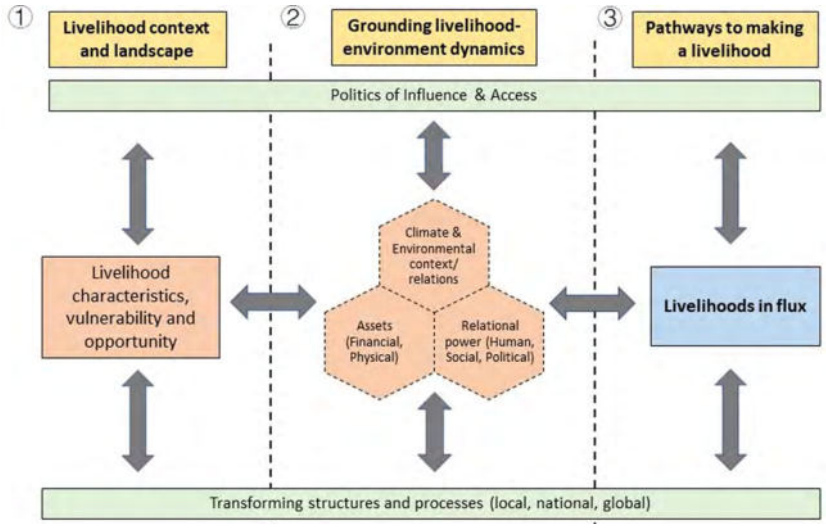

Figure 4: Illustration of Sustainable Livelihoods Framework[8]

Finally, the concept of **Coupled Social-Ecological Systems** (SES) ties-up all of the previously discussed frameworks into a holistic picture of interconnectedness, encompassing both internal (within the CURB) and external factors. A SES Framework includes much of the theory of common-pool resources and collective self-governance. It draws heavily on systems ecology and complexity theory and incorporates ideas from the study of resilience, robustness, sustainability, and vulnerability[9]. However, external factors are of critical importance in the context of the Cuando, because of the challenges posed by climate change, global economic turbulance linked partly to geo-politics, and shifting poltical and trade priorities at regional scale. SES can be illustrated as follows:

[8] Source: Natarajan et al. 2022
[9] Levin 1999.

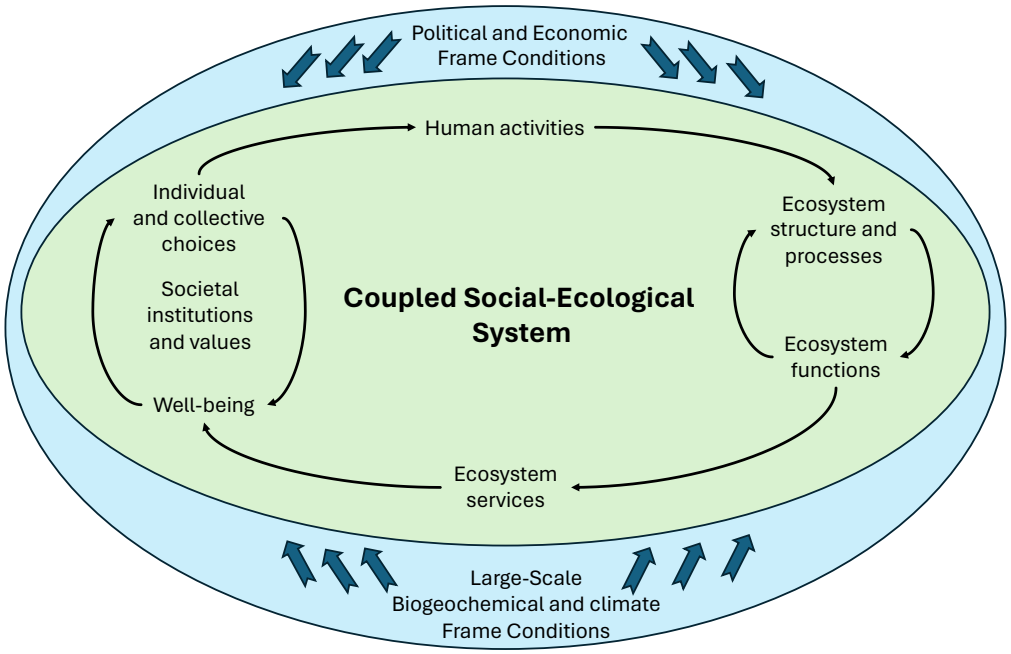

Figure 5: Illustration of Coupled Social-Ecological Systems[10]

Based on the aforementioned frameworks, a set of key socioeconomic issues were identified and organised around two dimensions: (i) human well-being and livelihoods, and (ii) economic activities. The key issues identified in the CURB are presented in Figure 6.

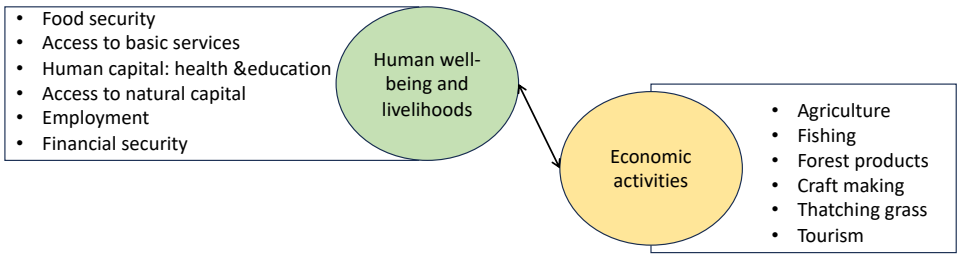

Figure 6. Main dimensions and key socioeconomic issues in the CURB[11]

Thus, the SEMMF recognises that human well-being, livelihoods, and economic activities affect and are affected by, a range of social and environmental factors. Nature provides ecosystem services, which safeguard human well-being and support economic activities by warranting security, basic needs, assets, health, and social relations. On the other hand, livelihoods and economic activities act as driving forces which exert pressure on the environment, degrading its state; these drivers of change will impact the state of the environment and, therefore,

[10] Source: Modified from Carson et al 2016.

[11] Modified from CORB SEA report

human health and economic activities, through increased environmental degradation and vulnerability.

3. Framework description

For the following three reasons, this SEMMF is focussed on ecological functioning:

1. Linkage to the CURB vision, which is - "A sustainable and resilient Cuando Basin for all by 2040",
2. Linkage to the six key VECS which need protection for the realisation of the CURB vision. VECs are defined as components of the natural and human environment that are considered by KAZA/ZAMCOM/WWF, Cuando Basin residents, scientists and other technical specialists, government agencies involved in the Basin, and the SEA team, to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance.
3. Linkage to ecosystem services, because these are vital for the livelihoods of the CURB's people, and the area's economy. This includes the viability of the small but very important tourism industry, and wildlife and habitat conservation in the entire KAZA landscape.

3.1. Indicator selection

Indicators can be calibrated to measure deviations from integrity, including deviations that are acceptable (healthy) or unacceptable (unhealthy). The acceptability of any given deviation is negotiated and determined by society via its policies and regulations. Compared with conditions embodied in integrity, conditions deemed unacceptable are more fluid, reflecting prevailing value systems. Further, what is unacceptable in one place may be acceptable in another, depending on societal goals. For example, the health of a wilderness forest and an industrial timberland might be assessed via different ecological criteria or indicators, even though they are both assemblages of trees with shared natural conditions. Even for intensively used ecosystems, however, we can set limits for the acceptability of ecological deviations. Consider a farm. If practices there damage the land for future farming or harm nearby waterways or people downstream, those practices and the resulting ecological conditions may be considered unhealthy. Regardless of which conditions are societally acceptable, ecological indicators can be calibrated objectively to distinguish the healthy from the unhealthy.

Numerous ecological indicators are in use, typically chosen to match the specific ecosystem and issue of interest. Some indicators reflect conditions at a given point in time (e.g., pH, number of species), while others reflect processes over a given time frame (e.g., annual soil erosion, population growth rate). Although many potential physical, chemical, and biological indicators can be measured, the biological assemblages that persist in a place provide the most integrative and instructive indicators of prevailing ecological conditions. Monitoring such

assemblages is crucial to understanding the full array of ecological consequences produced by human actions or natural events. Without regular biological report cards, humanity is ill-equipped to protect ecologically intact places, restore degraded places, or make informed decisions about how to manage natural resources. Thus, development of reliable, instructive ecological indicators is vital to society.

Accurately assessing ecological condition requires attention to the key factors and processes that drive ecosystem dynamics. This knowledge may be synthesized into a conceptual model of how factors and processes produce ecological outcomes (Lindenmayer and Likens, 2010), including biological responses such as changes in the behavior of an organism, changes in the abundance of a population, or shifts in the interactions among species. Such responses are important links to how people value ecosystems and view ecological health. Knowledge of species' life histories and habitat use is crucial to such models. Because ecosystems are dynamic, ecological assessments involve teasing the signals of interest from background environmental noise. Accurately interpreting such signals requires care in designing a monitoring protocol and selecting indicators to monitor. Translating monitoring results into management action further requires setting up thresholds for action that relate selected indicators to societal goals. For example, suppose monitoring shows that the ecological condition of a stream is unhealthy because of excessive sediment and bacteria attributed to livestock; that is, the stream's condition is unacceptable to local or downstream users who would otherwise benefit from the stream's flow. Managers might implement practices meant to improve the stream's condition and restore beneficial uses to stakeholders, such as restricting livestock access and planting riparian vegetation.

Indicators consist of quantitative or qualitative metrics that encapsulate the current conditions of a process, system, or entity, or that monitor their conditions over time. They confer a range of benefits in terms of knowledge, assessment, and objectivity, supporting the objectives of the proposed SEMMF, in relation to:

- **Simplicity and clarity** – indicators allow for the use of a range of available data, with the view of simplifying reality and complex issues, condensing information into a single value that is easily interpretable.
- **Knowledge** – besides providing a lens into the current state of a system, the use of indicators also provides a means to uncover social and economic trends, perform (temporal and spatial) comparisons, and to establish connections between indicators (namely, cause-effect relationships).
- **Monitoring** and **assessment** – the use of indicators across time allows for changes to be monitored over time, revealing changes that deem attention and/ or the need for corrective measures, and providing a way to assess progress against pre-defined goals, targets, or a benchmark. Moreover, by

monitoring indicators, policy makers can evaluate the success of interventions and, more generally, contrast policy benefits to costs.

- **Accountability**, **transparency**, and **awareness** – indicators confer a useful means to communicate results to the public as well as to raise awareness for accomplishments and/ or significant threats.

Departing from the set of environmental issues identified in the SEA, a set of indicators needs to be selected for monitoring efforts. As there is a wide variety of indicators which can be used to monitor specific issues, the challenge is to narrow an initial list of indicators down to a minimum set to ease interpretation.

Several available guidelines and criteria support indicator selection and enhance their appropriateness. CURB's SEMMF follows the SMART approach[12] which is widely recognised as a best practice approach for the development of monitoring and evaluation indicators. The acronym describes indicators that are[13]:

- **Specific** to what is being measured, i.e., the indicator measures what it sets out to measure, exhibiting a clear link to the issue which it relates to.
- **Measurable**, i.e., the indicator can be quantified or, alternatively, be measured adequately qualitatively.
- **Attainable**, meaning that the information required to present the indicator is available to be collected in a time- and cost-effective manner.
- **Relevant** to the objectives of the monitoring framework, providing useful information to guide planning, decision-making and management.
- **Time-bound**, implying that the indicator is responsive, being able to track changes over time and thereby reveal changes or trends that can be significant for management.

Where possible, the indicators selected are aligned with KAZA's indicators developed for the broader landscape.

The next subsection highlights the issues and the indicators selected to portray them.

[12] Doran 1981
[13] Minor variations related to the terms used to define the acronym can generally be found across applications. The presented terms can be considered the ones that are most commonly used (Bertule, et al., 2017).

4. High-level targets

Whilst the SEMMF is primarily a framework for management and monitoring actions at basin-level, it is appropriate to first provide a contextual setting of key management objectives. This is so that there are common high-level targets, whereafter monitoring indicators are further elaborated. These proposed high-level targets are discussed below:

Strategic, trans-frontier level

- Based on the Cuando Basin vision, initiate a dialogue (through KAZA/ZAMCOM) that achieves agreement on catchment management, water offtakes and developments in and along the Cuando. This may be done immediately (on the basis of the SEA) or possibly by extending the process of SEMMF consultations that leads to a firm agreement of its key messages by all Riparian States. The Member States must agree on what activities are appropriate in their part of the basin so that there is clarity on desirable/appropriate development activities. Usually there is a need for negotiation or trade-offs, especially given the fact that virtually all of the Cuando's water originates in Angola.
- Greater advocacy so that the KAZA transboundary conservation initiative gains greater and sustained momentum. KAZA is the key mechanism for achieving the desired opening of systems that will enable improved mobility for wildlife and tourists, and socio-economic synergies between the participating States.

Strategic, local level

- Restore connectivity, by reducing barriers that prevent wildlife from moving through the and between neighbouring systems. The barriers of concern are inappropriately aligned fences and human settlements. Fences (or critical sections) should be removed, and corridors kept open between human settlements and fields. These corridors must correspond with known wildlife movement paths, and the gaps need to be wide enough so that they are used.
- Avoid allocating exploration or mining/petroleum licenses anywhere within the basin.

Local level

- Show commitment to CBNRM by building on existing programmes that build on successes achieved in other countries in the region. It is essential to demonstrate intent to communities that may feel marginalized and disillusioned, and that have few incentives to tolerate or conserve wildlife.
- Promote climate-smart agriculture, so that people in certain areas can grow crops in an ecologically appropriate way and so that the best possible yields can be eked out of the marginal soils on offer.
- Get the tourism sector to commit to achieving 'best practice', by implementing existing or emerging Ecotourism Certification Systems. This will enable the sector to address many of

the negative impacts attributed to tourism, and help the establishments to earn a reputation for being 'eco-friendly'. This will benefit them and the region's reputation in the long term.

- Actively protect (especially) the riparian woodland by whatever means possible, especially enforcing a ban on logging within the CURB, and preventing fires.

Proposed targets

1) Hydrological functioning, water quality and biodiversity

- No significant human-induced change in the natural flood pulse peak (the extent of peak flooding that provides the maximum area of seasonal and occasional floodplain) or loss of permanent swamp beyond the lowest dry period flood level, recorded in 1995. Annual offtake from the entire basin must not exceed 600Mm^3 per annum (based on inflow at the Kongola measuring station).
- No upriver dams or other impoundments.
- Water quality to be within 5% of current fluctuations as measured over the past 15 years.
- Existing fences are removed wherever possible, especially in between Namibia and Botswana.
- Reverse declines of indicator species.
- Reverse large mammal species population declines to 1994 levels; e.g. lechwe, buffalo, tsessebe, and zebra.
- Maintain integrity of the riparian fringe – no more clearing of riparian habitat for agricultural or any other form of land use and implement rehabilitation of already impacted areas.
- No introduction of alien invasive species (especially plants and invertebrates) and eradication of aliens where they exist already.
- Reduce human-wildlife conflicts: farming must avoid prime wildlife areas and designated wildlife corridors, and installation of protection devices/ strategies used to mitigate further conflict.
- Implement the KAZA Elephant Management Plan.
- Maintain viable populations of endemic, rare and endangered species.
- Promote and improve support to CBNRM projects in order to enable communities to earn tangible benefits from sustainable natural resource management and, thereby, actively participate in natural resource conservation through wise use practices and appropriate monitoring, i.e. using MOMS
- Poaching should be reduced to zero (CBNRM and law-enforcement are key tools in this regard).
- Reduce fire frequency to a rate of one in 3-5 years and promote cool burns.

2) Livestock farming

- Limit livestock to rangelands further away from key biodiversity areas (e.g. riparian fringe) and stock appropriately (recommended stocking rate -16ha/LSU in sandveld).
- No fenced commercial ranches or disease-control fences – unless EIAs show they will not impact biodiversity significantly.

3) Arable agriculture

- Water offtake (all sectors combined) should be limited to less than 600 Mm^3/a so as not to compromise ecological integrity of the wetlands.
- Future molapo/dambo and horticulture farms should not be placed within nor extract wood from, the riparian fringe for any purpose whatsoever.
- Human-wildlife conflicts need to be reduced by locating fields away from prime wildlife areas, including migration routes.
- Principles of climate-smart agriculture[14] should be rigorously applied to reduce habitat alteration and soil exposure while improving farming efficiency and crop yields.
- Levels of fertiliser and chemical inputs need to be controlled to minimise toxic inputs into return flows to surface waters or pollution of groundwater.

4) Tourism

- Maximum 700 beds in the Namibian and Botswana area, and maximum 24 beds per lodge - no determination yet for other areas, but expansion probably possible in Angola.
- Improve equity (through local ownership and improved benefit sharing).
- Reduce conflicts with subsistence fishers/villagers.
- Improve general housekeeping at tourism establishments – including:
    - Appropriate solid & hazardous waste management,
    - avoiding creation of artificial waterpoints,
    - reducing boating impacts on wildlife and habitats (especially riverbanks),
    - reducing vehicle disturbance of wildlife,
    - reducing noise (aircraft, generators, boats),
    - avoiding artificial alterations of water flow (through erecting barriers & establishing/maintaining channels),
    - ensuring appropriate architecture,
    - limiting footprint of lodges,
    - avoiding proliferation of vehicle tracks and reducing traffic congestion (especially in self-drive areas).

[14] https://www.fao.org/climate-smart-agriculture/en/

5) Mining

- The overall objective is no prospecting and/or mining licenses issued within the CURB and existing licenses to be withdrawn by the Member State as soon as they are relinquished by the current license-holder.

5. Project level decision support tool

A complex SEMMF may be overwhelming/theoretical and of little practical help to decision makers, especially mid-high level government officials. Whilst the ToRs required the Systematic Conservation Plan to be the spine of the Decision Support Tool, it was decided to compliment this with a simple tool to assist decision makers when they are confronted with a development proposal that requires a decision. In reality, this is what happens and what government officials deal with. In practice, decisions have to be taken with incomplete knowledge and under political pressure. The attached basic decision tree is a simple flow-chart-like structure in which each node represents a "test" on an attribute. Eventually, the ultimate test is consistency of the proposed activity/project with the Cuando vision and the integrity of the VECs and their respective ecosystem services.

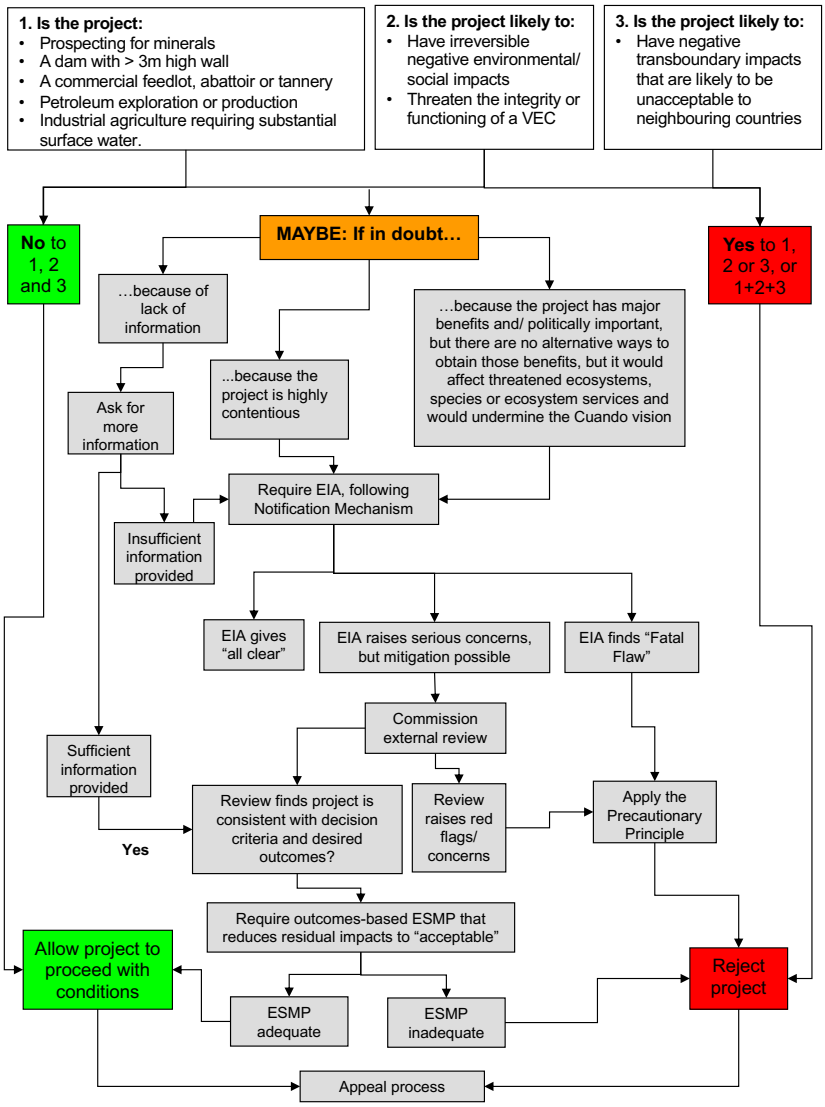

Figure 7: Project-level decision support tool

6. Implementation and reporting

6.1. Roles and responsibilities

The SEMMF is intended to allow for a basin-wide application and to provide an accurate and timely picture of selected components of the basin's environment.

The data required to monitor the indicators will be derived from primary and secondary sources, surveys, administrative reports and other sources provided by the basin states. To this end, CURB MSs have the responsibility to make all necessary data available for assessment and reporting.

All data contained in the SEMMF should be centralised in a common database, which is to be maintained by the KAZA/ZAMCOM Secretariat. Within the scope of the SEMMF, KAZA/ZAMCOM will thus have the following responsibilities:

- manage and articulate data requirements from MSs;
- data quality control;
- coordinate data sharing between MSs;
- integrate, store, and maintain the collected data in an accessible format, including performing data cleaning and pre-processing activities. These responsibilities should fall under the specific role of a specialised and experienced Data Officer.

Reporting activities will be the responsibility of a dedicated official, which will be tasked with guaranteeing that regular reports are completed and made available on time, analysing the collected data, and drafting the report, highlighting trends, data constraints and providing recommendations.

It is recommended that KAZA/ZAMCOM contract an organisation to manage the SEMMF (e.g. WWF), and produce a Cuando Basin Report Card every 5 years, based on the indicators, but also including an update on the state of the VECs. The latter can draw on many of the indicators already proposed, augmented by wider surveys and observations. Also, a "coalition of the willing" or "friends of the Cuando", needs to be assembled – researchers, NGOs, tourism operators, etc – all who might help with monitoring and data gathering.

6.2. Reporting

The information gathered under the SEMMF should be made available to all stakeholders and the public in order to reach a common understanding of the state of the basin and raise awareness for appropriate measures that should guide future management policies.

In this respect, a report outlining the socioeconomic state of the basin should be compiled every five years. This periodicity is regarded as sufficient to allow significant changes to be highlighted and thus respond to the necessities of users. The report should hence emphasise not only the current state but also past trends of individual indicators, to the extent of data availability.

The report should be publicly available through KAZA/ZAMCOM's website, and its conclusions should be presented to the wider public following an effective communication strategy.

All indicators were selected to be attainable, i.e., required data are available or can be collected in a cost-effective manner. Notwithstanding, with the evolution of data collection methods in the basin, further indicators may be added to the SEMMF in the future, allowing a more detailed SEMMF. Fortunately, Geographical Information Systems and Remote Sensing methods are becoming more accessible at low costs and may enhance socioeconomic data collection in the CURB.

Concurrently, CURB MSs may adhere to new international compromises and establish new national development goals, what would require changes in SEMMF indicators to ensure alignment with the new international and national commitments.

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8. Indicators

Theme 1: Human wildlife co-existence

Linked to VEC 5 (Wildlife corridors and ecological connectivity)

#	Name	Description	Purpose	Units	Collection frequency	Data source	Who	Compilation format
1	Incidence of HWC	Number of Human Wildlife Conflict event reports (HWC).	Incidences and locations of HWC indicate priorities areas for mitigation. For more information, see the Socio-Economic Baseline Survey for the KAZA TFCA and the framework for monitoring and evaluating (2014).	Number	Annual data collection, report triennially	MS conservation agencies	MS agencies, coordinated by KAZA	Spreadsheet, mapped per area for illustration, and graphs with trends
2	Tolerance towards wildlife	Extent to which communities are tolerant towards wildlife	A proxy for understanding how well CBNRM is working or received, including perceptions about wildlife cost vs benefits	%	Statistically viable survey done triennially	Data gathered by survey consultancy	Consultancy coordinated by KAZA	Spreadsheet, mapped per area for illustration, and graphs with trends

Theme 2: Conservation and connectivity

Linked to VEC 4 (Western flanks of the Cuando) and VEC 5 (Wildlife corridors and ecological connectivity)

#	Name	Description	Purpose	Units	Collection frequency	Data source	Who	Compilation format
1	Extent of Conservation Areas	Total extent of conservation areas (CAs) officially designated in the CURB. CAs calculated as total and % of country, wildlife dispersal area,	Assessing MS committment to setting asidev land for conservation, and to assess extent of habitat fragmentation etc.	Ha	Annual	MS	Consultancy coordinated by KAZA	Spreadsheet. mapped per country for illustration, and graphs with trends

		and habitat type throughout CURB.						
2	Presence of Approved Conservation Area Mgt Plans	% of conservation areas with approved management plans	To assess MS commitment to formalise management objectives and strategies – though does not gauge actual implementation	%	Triennial	MS	Consultancy coordinated by KAZA	Table
3	Land cover	Natural land cover (total hectares and % of area) available for wildlife habitat	Wall-to-wall mapping of vegetation and land cover from satellite imagery is efficient and consistent for providing information on natural habitats	Ha translated into %	Triennial	GIS mapping	Consultancy coordinated by KAZA	Table and map
4	Wildlife Movement through corridors	Species presence in corridor areas - wild dog, zebra, buffalo, elephant	Demonstrates movements of wildlife and natural migration	Constant/ regular/ occasional/ rare	Annual	Camera traps, ground surveys, interviews, collared animals	Consultancy coordinated by KAZA – support by local NGOs and researchers	Table – showing all recognised corridors
5	Fire Extent and Frequency	The extent, frequency and timing of fires, by land cover.	Fires, in certain land cover types at certain times are an indicator of anthropogenic activity. Fires can also drive wildlife movements.	Ha translated into %	Triennial	GIS mapping	Consultancy coordinated by KAZA	Table and map
6	Illegal trade & poaching	Number of poaching incidents, seizures, poaching attempts, and recorded illegal trades reported in each country	Tracking trends in illegal harvesting, transit and trading	Number per species per area	Annual	MS law-enforcement agencies supported by NGOs	Consultancy coordinated by KAZA	Table and map
7	Buffalo Population	Buffalo Population estimates, numbers of individuals	Buffalo are an indicator of ecosystem plant health. Buffalo distribution helps determine where ecosystems are providing grazing vegetation and potential of diseases for livestock.	Number per area	5 yearly	Aerial surveys and ground surveys	Consultancy coordinated by KAZA	Table and map

8	Elephant population	Population estimates, numbers of individuals	Elephants are flagship species. Landscape engineers, indicators of healthy ecosystems. There have been barriers to their movements which has affected landscapes locally.	Number per area	5 yearly	Aerial surveys and ground surveys (consistent with 2023 KAZA census)	Consultancy coordinated by KAZA	Table and map
9	Hippopotamus population	Population estimates, numbers of individuals	Hippos are important to wetland ecosystems, ecosystem engineers	Number per area	5 yearly	Aerial surveys and ground surveys	Consultancy coordinated by KAZA	Table and map
10	Ground Hornbill population	Population estimates, numbers of individuals	Tree nesting birds which are an indicator of ecosystem health	Number per area	5 yearly	ground surveys – include juv:ad %	Consultancy coordinated by KAZA	Table and map
11	Lion Population	Population estimates, numbers of individuals	Top carnivores indicate intact wildlife food chain	Number per area	5 yearly	ground surveys, spoor, camera traps	Consultancy coordinated by KAZA	Table and map
12	Wild Dog Population	Population estimates, numbers of individuals	Top carnivores indicate intact wildlife food chain	Number per area	5 yearly	ground surveys, spoor, camera traps	Consultancy coordinated by KAZA	Table and map

Theme 3: Rivers and wetlands Linked to VEC 1 (Angolan Highlands Water Tower and perennial supply of water along the length of the Cuando River), VEC 2 (The immense area of swamp or reedbeds, VEC 3 (Linyanti Swamps and Savuti area) and possibly VEC 6 (Cuando aquifers).								
#	**Name**	**Description**	**Purpose**	**Units**	**Collection frequency**	**Data source**	**Who**	**Compilation format**
1	Number of kilometres of free-flowing rivers maintained	River connectivity 2022: 730 km (equivalent to mainstem of Kwando River)	River connectivity Number of kilometres of free-flowing rivers maintained	km	annual	GIS	WWF-US & WWF Zam freshwater team and data	Table
2	CURBs freshwater habitats and ecosystems are secure through multi-stakeholder governance and improved river management.	Annual average discharge averages 1,0 million Mm^3. The maximum measured was 2,200 Mm^3 being 4.5 times higher than the minimum of 490 Mm^3.	Cuando Environmental Flow is maintained to support downstream ecosystems and livelihoods. Annual flow regime of the Cuando remains within the recorded fluctuating flow frequency and intensity	Mm^3	Annual	Kongola Measuring station (add details on new stations recently installed)	Namibian DWA	Graphs, showing time sequence

Theme 4: Environmental and Social Safeguard tools

Not linked to any specific VEC, but highly relevant to them all.

#	Name	Description	Purpose	Units	Collection frequency	Data source	Who	Compilation format
1	Consistent application of EIAs to major developments/activities	All major activities or projects undergo a high standard EIA prior to decision making – in conformity with national legislation.	Best practice adherence to environmental and social safeguard tools, as provided for in national legislation. Where appropriate, subject EIAs for complex projects to independent reviews.	Number	Annual	MS, with verification from ZAMCOM and KAZA	ZAMCOM to initiate, MS's Competent Authority to provide information	Short description of project/activity in template to be provided
2	Adherence to ZAMCOM Notification Mechanism in the case of likely transboundary impacts	Any projects/ activities referred to above that will likely have transboundary impacts strictly follow the ZAMCOM Notification Mechanism	As above – but ensuring that all CURB states, whether upstream or downstream of the envisaged project/activity, are adequately consulted as stipulated in the ZAMCOM Notification Mechanism.	Number	Annual	MS, with verification from ZAMCOM and KAZA	As above	Short description of project/activity in template to be provided

Theme 5: Development pressure

Not linked to any specific VEC, but highly relevant to them all.

#	Name	Description	Purpose	Units	Collection frequency	Data source	Who	Compilation format
1	Human Population Density	Scoping report estimates 201,795 in 2023 but State of Basin Report estimates 274,330 in 2022. No target – just monitor	Indicator of human presence, and density is important for determining threat and pressures from development, HWC etc	number	Every 10 years	MS Statistics agencies	KAZA to obtain and coordinate	Table with trends, and map for illustration
2	Human Settlements	Estimated 15,984 ha in 2023 (see scoping report). No target – just monitor	Human presence and expansion a proxy of pressures from development and potential clashes with wildlife and corridors.	ha	Every 10 years	GIS	Consultancy coordinated by KAZA	Table with trends, and map for illustration
3	Roads, bridges, canals	Extent of road bridges, canals infrastructure in the CURB. No target – just monitor	A proxy for determining future pressures from secondary development and potential clashes with wildlife and corridors	km	Every 5 years	GIS	Consultancy coordinated by KAZA	Table with trends, and map for illustration
4	Tourism infrastructure	Total number of beds and facilities available to tourists or overnight guests. Estimated 610 beds in 2023 (see scoping report). Target is less than 700 in total.	Indicator of tourism expansion and a proxy for determining pressures vehicles, boats, waste generation, and potential clashes with wildlife and corridors	number	triennial	Survey of lodges	Consultancy coordinated by KAZA	Table with trends, and map for illustration
5	Land cleared for agriculture	Estimated 107,360 ha in 2023 (see scoping report). No target possible – just monitor	Indicator of development expansion and potential clashes with wildlife and corridors	ha	Every 5 years	GIS	Consultancy coordinated by KAZA	Table with trends, and map for illustration