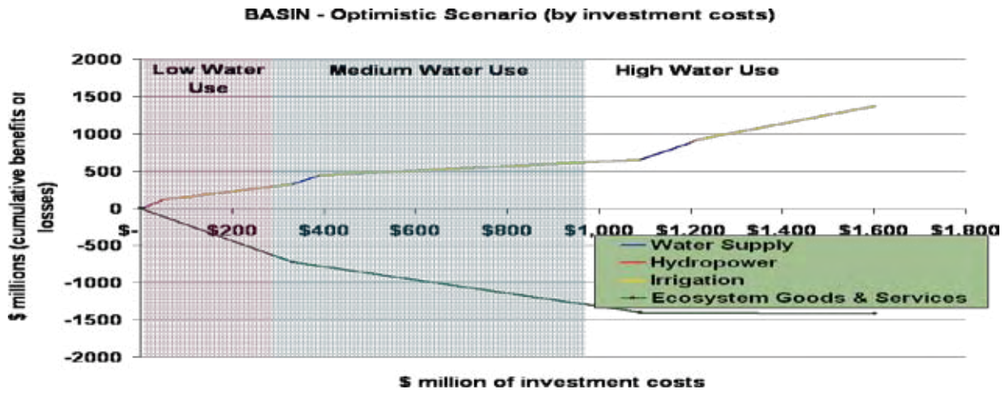
The graph below shows the tradeoff in macro-economic benefits to the basin as investments costs on water resources development increase.



INFORMING THE PLANNING PROCESS

The principal pressures on the Okavango River Basin come from increasing demand for water, other natural resources and changing land use. Populations in the Okavango basin are steadily increasing, and so is the demand for goods and services. By following the trends in population and development, it is possible to describe how pressures on water, land and other resources may increase. At the same time, developments in different sectors using these land and water resources are being proposed, some of which will take place in the next 10 to 15 years. When planning their activities the countries need to consider the following:

- Flow variability is key to the continued functioning of the ecosystem. The benefits people and nations derive from the river are dependent on this. All proposed developments should consider the impact on the hydrology of the river.
- Irrigated agriculture in the river basin's poor soils has the potential to extract large amounts of water and affect water quality. Careful planning is essential.
- The Cuito tributary, if water resources development is limited, can buffer other developments by moderating flow fluctuations, diluting pollutants and by continuing to supply the crucial bed-load sediment.
- Hydroelectric power tradeoffs are largely positive, especially considering run-of-river schemes located on tributaries. But they must have effective mechanisms for allowing the continuous flow of sediments, ensure that discharge of poor quality waters from reservoirs is avoided, and that migrating fish still find their way.
- Providing water to people living in the river basin is unlikely to have severe impacts, as long as growing urban areas incorporate good municipal water and sanitation systems. Only major water supply schemes should be presented for joint discussion among the countries.
- Considering the high costs of treating contaminated water, conserving the good water quality of the Okavango offers the most cost effective option.
- While diversion of water out of the basin is likely to use lower quantities of water than irrigated agriculture, the hydrological implications of any large diversion schemes should be discussed among the three countries.
- Conservation of river banks and buffer zones can allow riparian vegetation to recover in urbanized areas, and protected areas can support wildlife migration and tourism. The links between land use and water management are important, considering the river basin's poor soils.
- The benefits of water resources intensive development pathways seem to be lesser than benefits of other development pathways. The current near pristine state of the river basin is a clear comparative advantage for the Okavango.

Through this exercise, OKACOM aims to identify opportunities and concrete projects and programs needed to balance the needs of conservation and development. The specific initiatives, likely funded and executed by various organizations but coordinated by OKACOM, will be packaged in the Strategic Action Plan to form an Integrated Management Strategy for the Basin.

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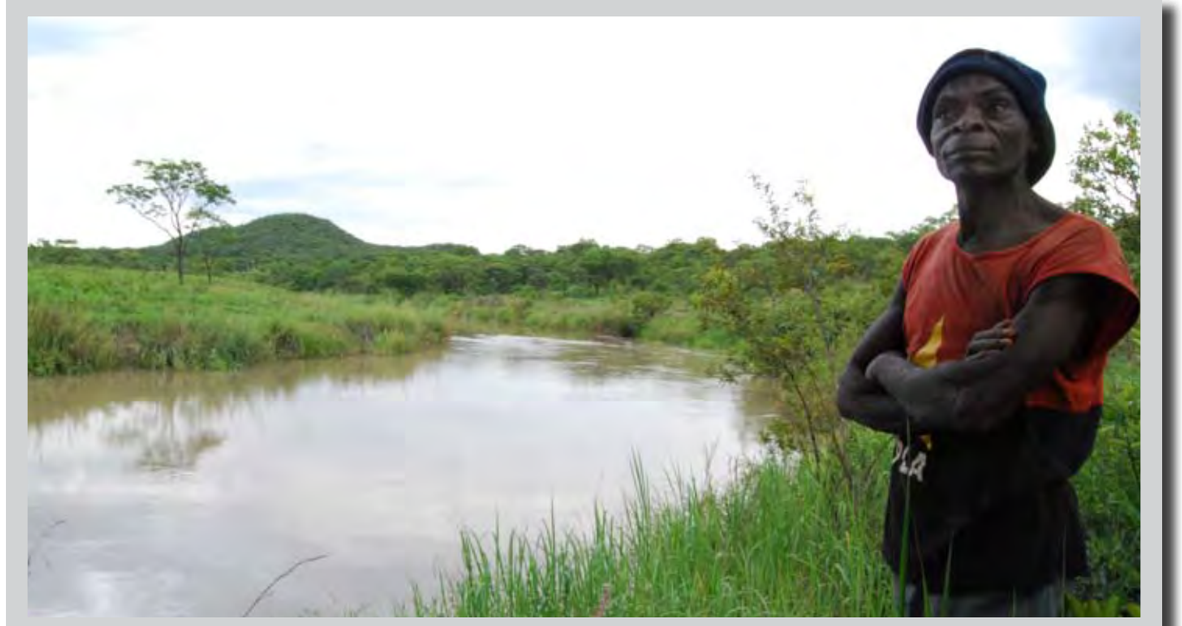
The Okavango River Basin

Transboundary Diagnostic Analysis:

Reimagining the river



In 1994, the three riparian countries of the Okavango River Basin – Angola, Botswana and Namibia – agreed to plan for collaborative management of the natural resources of the Okavango, forming the Permanent Okavango River Basin Water Commission (OKACOM). In 2003, with funding from the Global Environment Facility, OKACOM launched the Environmental Protection and Sustainable Management of the Okavango River Basin (EPSMO) Project to coordinate development and to anticipate and address threats to the river and the associated communities and environment. The project is implemented by the United Nations Development Program and executed by the United Nations Food and Agriculture Organization.

The Okavango River Basin is unusual in that its waters and shores are relatively pristine, protected for many years by low human population pressures. In its upper reaches, a long conflict in Angola restricted opportunities for development. Experience throughout the world has shown that remedial action is invariably more costly than wise management. OKACOM designed the EPSMO Project to evaluate the condition of the river basin, to identify possible threats posed by increasing demands on the benefits of the river system and to develop a program of policy, legal and institutional reforms – a Strategic Action Plan – to meet and manage these demands. The first step was a Transboundary Diagnostic Analysis (TDA).

OKACOM

THE TDA

Innovative methodology was used to design and carry out the TDA process. Whereas most TDAs identify existing problems, the Okavango TDA was designed to identify potential problems in the future, based on water use scenarios.

Based on sound scientific analysis and expert opinion this TDA aimed to anticipate the environmental, social and economic impacts and the requisite policy and institutional challenges of flow regime change due to water resources developments in the basin such as abstractions, impoundments, land use change and climate change.

The Okavango TDA took the present state of the basin, and projected water use trends into the future and anticipated the threats and potential consequences that might arise from a development pathway based on increasing water resources development, providing a bridge between water resources development and the potential for accruing global benefits without generating further loss of ecosystem function.

SCIENTIFIC TEAMWORK

In 2008, a full multi-disciplinary team was appointed in each country, with specialists in hydrology, hydraulics, channel form, water quality, vegetation, aquatic invertebrates, fish, birds, river-dependent terrestrial wildlife, resource economics and socio-cultural issues, coordinated and managed by a group of specialists from the southern African region.

The teams began with analysis of the baseline and emerging trends – the present state of the Okavango. Then, based on the observed trends and national development plans, three water resources scenarios were developed jointly with OKACOM identifying specific irrigation, hydro-electricity and water abstraction projects. Three hydrological models were then developed to describe the actual hydrological response to these water uses. Then, through extensive field surveys and research and a structured and detailed scientific and participatory exercise, the project built up a database of ecological responses to these hydrological changes. The ecological responses were then also translated into socio-economic impacts based on community direct and in-direct use and livelihood dependence on river resources identified through detailed community surveys in the basin.

An in-depth assessment of eight representative sites provided the scientific basis for this analysis by linking water resources development with flow, ecology and socio-economics at the specific sites. Then further basin-wide studies allowed these observations to be extrapolated to the rest of the basin and also highlighted basin-wide trends and issues possibly emerging from the changes in the river. The 'links' connecting developments in one country to impacts in another are the four characteristics of flow: timing, quantity, quality and sediment. The Okavango causal chain analysis was predictive of problems that may arise as a result of future development in the basin. Climate change, as an overarching factor, was judged important enough to be given its own separate study.

Emerging human and natural trends found by the research teams include:

- Population increasing steadily at rates of 2.7% in Angola, Namibia (urban 2.5%, rural 1.5%) and in Botswana 1.5%.
- Food self-sufficiency policies expected to increase irrigation from 3000 ha to 200 000 ha by 2025.
- Tourism growth exceeding 3% per annum.
- Up to 12 hydroelectric projects under consideration in response to regional demand.
- Increasing urbanization: at least 2.5% vs 1.5% in rural areas.
- Climate change: long term variability of wet and dry seasons.

THE SCENARIOS

Four development scenarios re-imagine the river basin by 2025. While these scenarios were based on actual proposed developments, they aim at creating understanding of potential impacts rather than predicting specific outcomes.

Scenarios

Based on proposed basin developments

Present
2700 ha irrigation, urban water demand in three centres.

Medium
205000 ha irrigation. One storage and four run-of-river hydrostations. One interbasin transfer of 17 mm^3 per annum.

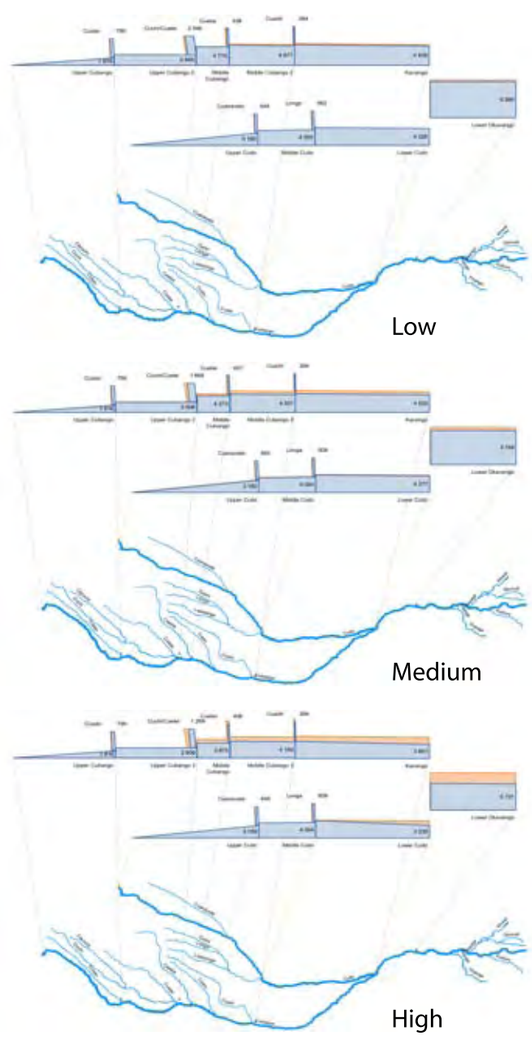
Low
Increased urban consumption due to Angolan resettlement. 2100 ha irrigation. One storage and three run-of-river hydrostations.

High
350000 ha irrigation. One storage and nine run-of-river hydrostations. Extended interbasin transfer of 100 mm^3 per annum. Additional urban water development scheme.

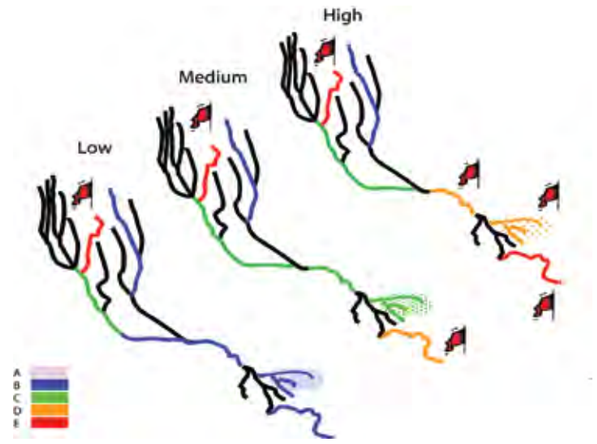
FINDINGS

The results describe the specific consequences of individual planned water resources developments as well as general pressures on the basin. The findings present a detailed and illustrative picture of the causes and impacts of changing water use along the river showing the hydrological impacts of water use for irrigation, hydropower and domestic use in terms of key flow parameters such as changes in flood patterns and the onset of seasons. The ecological impacts of these changes are described per site and are extrapolated for the basin. The socio-economic consequences and macro-economic tradeoffs are described in detail.

The graphs below illustrate how the Mean Annual Runoff (10^6 m^3/a) is reduced for low, medium and high water use scenarios (Blue) compared to Present Day (Orange).



The maps illustrate expected changes in ecosystem integrity for the scenarios. Present-day conditions are estimated as B-category. Degradation is indicated from low (A) to high (E).



The graph below describes the short term implications for river resources based livelihoods with present day (PD), low (Low Dev), medium (Med Dev) and high (High Dev) water use scenarios (US$ 2008)