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From science to management: the Okavango Basin Transboundary Diagnostic Analysis as an aid to basin planning

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1. Background

River systems can exist at different levels of condition (health), from pristine, when they provide a range of natural ecological services of benefit to humans (Table 1); through various stages of human-induced change, when the original ecosystem services may disappear and other characteristics appear; to serious degradation, when virtually all ecosystem services essentially disappear.

Table 1 Natural aquatic ecosystem services recognised in the Millenium Ecosystem Assessment

Provisioning Services	Regulating Services	Cultural Services
• Edible plants and animals • Fresh water • Raw materials: rocks and sand for construction; firewood • Genetic resources and medicines • Ornamental products for handicrafts and decoration	• Groundwater recharge • Dilution of pollutants • Soil stabilisation • Water purification • Flood attenuation • Climate and disease regulation • Refugia/nursery functions	• National symbols and borders • Religious and spiritual enrichment • Aesthetic appeal • Inspiration for books, art, photography and music • Advertising • Recreation
Supporting Services Nutrient cycling, Soil formation, Pollination, Carbon sequestration, Primary production		

At the different stages of change the ecosystem services that appear may be more or less welcome than those that disappear, and at every level there are both benefits and costs to society. As an example, the Provisioning Services provided by a pristine river ecosystem might be water of good quality; an abundant fishery; and a centre of genetic diversity for future medical and scientific exploitation. The Regulating Services provided might include extensive floodplains that store floodwater and so ensure year-round river flow and moderate-sized floods; and good bank stability brought about by a complex community of riparian trees, and thus low sediment loads in the river. The Cultural Services could include its National Parks-type setting and thus very high recreational and aesthetic value. These and more could collectively be called the *benefits* provided by this river system. Among the *costs* to people of this system are that the land and water are not in use for agricultural or industrial production, and water may not be assured for any off-stream users during dry periods because flow has not been dammed and stored.

In the early stages of development, water quality, the fisheries, the floodplains and the recreational value might decline and some species disappear even before they are known to science (costs), but the development project, perhaps a dam, that caused this, will have led to increased food or energy production or allowed people to have running water in their homes (benefits). With further off-stream developments that provided more of these kinds of benefits, flow in the river might reduce to the point where the fishery disappears, the floodplains dry out, the riparian trees die and lead to extensive bank erosion and siltation (and thus reduced life) of downstream reservoirs, water quality might become so poor that expensive water purification plants are needed before people can use the water, and the area may no longer be of use for any kind of recreation (costs). At this point, the costs may be seen as unacceptably high. People might feel that too much has been lost, and that a bottom line should have been drawn at some earlier point that represented an acceptable trade-off between development and protection of the river and its natural resources.

The fact that people did not draw a line earlier is now obvious in river systems across the world. As the era of large dams began in the early 1900s, it soon became apparent that flow manipulations away from natural were extensively degrading river systems. We have gradually recognised globally that rivers are living systems and that as we impose change upon them and their drainage basins with land and water developments, they will in turn respond by changing. Changes in the flow regime have the potential to do most damage to the river as flow is recognised as the 'master variable', driving the nature and functioning of the whole river ecosystem. Actively managing the health of river ecosystems is important because of the great range of services they provide– many of these are 'hidden' or 'silent' services that we do not think much about, but they nevertheless are providing essential support of great value to people. Farmers along Australia's largest and highly-degraded river, the Murray-Darling, are often quoted: "If we had made our mark in the sand (ie managed diversions with the water needs of the river in mind) 50 years ago, we would not be in the mess we are now". 'The mess' was over-allocation of water, intense conflicts over water, very poor water quality including toxic algal blooms, and a severe loss of ecosystem services. This situation is now being addressed through 'clawback' of water from established users and a recent stepping in of the Federal Government to coordinate water allocations and recovery of the whole river system.

This story is being repeated endlessly across the world. With hindsight, it is clear that whilst the case for developing rivers has been effectively promoted by engineers, economists and water managers (the top block in Table 2), the case for doing this with due consideration for the condition of the targeted rivers and their users has not, until very recently, been well articulated by ecologists, sociologists and resource economists (the bottom block in Table 2). Without this input, decision makers could understandably strive for development scenario E in Table 2, seeing only benefits. With the additional information contained in the bottom block, however, scenario E might appear less attractive and some earlier scenario, represented here by scenarios A to D, might be seen by government(s) and other stakeholders as the optimum trade-off between costs and benefits. The flow regime encompassed within this optimum trade-off scenario would become the environmental flow (EF) for that river, representing the agreed trade-off between development and resource protection for that basin and that society.

The bottom block has become the responsibility of river, social and resource-economic scientists, and completing it in harmony with the top block is sometimes called an Environmental Flow Assessment, or an Integrated Flow Assessment or a Strategic Environmental Assessment.

Table 2 Hypothetical example of the matrix of information that could be developed for each part of a river basin. The indicators would be more numerous than shown and would differ from river to river. The crosses represent the level of beneficial use under each scenario as gleaned from research and are used here merely to illustrate possible trends in the status of each indicator. PD = Present Day – not necessarily pristine.

Indicators	**Scenarios of increasing levels of basin development**					
	PD	**A**	**B**	**C**	**D**	**E**
Man-made benefits						
Hydro-power generation	x	x	x	xx	xxx	xxx
Crop production	x	x	xx	xxx	xxxx	xxxx
Water security	x	xx	xxx	xxx	xxxx	xxxx
National economies	x	x	xxx	xxxx	xxxx	xxxx
Aquaculture	x	xx	xxx	xxx	xxx	xxx
Ecosystem attributes						
Wild fisheries	xxxx	xxx	xxx	xx	xx	x
Water quality	xxx	xxx	xx	xx	x	x
Floodplain functions	xxxx	xxxx	xxx	xx	x	x
Cultural, religious, recreational values	xxxx	xxx	xxx	xxx	xx	xx
Ecosystem buffer against need for compensation of subsistence users	xxxx	xxx	xx	xx	x	x

Whatever the name, the approach is multi-disciplinary and can illustrate, for any considered development option, the potential changes in, for instance, channel configuration; bank erosion; water chemistry; riparian forests; river, estuarine and near-coastal marine fisheries; rare species; pest species; human and livestock river-related health; availability of baptism areas; household incomes; GDP; job creation; HEP production and much more. Decision makers in several countries receiving such outputs from Flow Assessments have commented that they have never before understood, or often even been aware of, the wider implications of development decisions they make.

Providing both sides of the development picture in this way, for discussion and negotiation by governments and other stakeholders, meets the requirements of Integrated Water Resource Management (IWRM). IWRM is defined as ‘a process that promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems’ (Global Water Partnership 2000). It is a relatively new concept that promotes sustainable use of water, encouraging people to move away from traditional project-driven ways of operating and toward a larger-scale basin or regional approach that takes into account the overall distribution and scarcity of water resources and the needs of other potential water users

Such an approach was used to provide information for the Okavango Basin Transboundary Diagnostic Analysis (TDA).

2. The TDA Integrated Flow Assessment

A major part of the TDA was a set of predictions of the costs and benefits that could arise from water-resource development, in other words, aiming to provide decision makers with the information represented in Table 2. Chapter 5 of the TDA and Report 08 of the Flow Assessment provide full details and these are summarised briefly below with a few examples.

The predictions were presented as a set of water-use scenarios, each of which represented a possible level of future water use as described in Box 1. The predictions were made by a basin-wide scientific team guided by and an international process management team.

Box 1   Scenarios

The water-use scenarios assessed are simply ways of exploring possible management options. None of the scenarios described in this study will necessarily happen but they could. They are designed to alert the Okavango Basin countries to possible future benefits and problems and help them identify, through negotiation, a preferred future pathway. The scenarios were chosen through an iterative process of discussion between project staff, OKACOM and other government representatives. The most important of these meetings took place in Maun in November 2008 when two major decisions were made:

1. The scenarios would be development-based rather than sector-based. In other words they would explore a progressive growth in water use through various kinds of development, rather than exploring the implications of, for instance, maximising basin-wide hydropower generation or basin-wide irrigated crops.
2. The scenarios would represent three levels of potential water use in the basin: Low, Medium and High. The Low water-use Scenario would equate approximately to the three countries' present short-term (i.e. 5-7 years) national plans. The Medium water-use Scenario would reflect possible medium term (approx 10-15 years) plans, and the High water-use Scenario possible long-term (>20 year) plans.

Major water uses included in the scenarios were hydropower generation; agriculture, including irrigated crops and livestock; mining and industrial; growing numbers of people in urban areas and as tourists; and inter-basin transfers of water.

The details of where to place individual potential developments within the basin hydrological model were decided by the hydrological team after consultations within their respective countries. This does not imply that any one of these developments will happen or, if it happens, that it will be in the location indicated in the model. Modification of the site of a development, or of its design or operating rules, could affect the consequent flow regime and thus the predicted ecological and social impacts.

The creation of a Decision Support System (DSS) for this project enables many permutations of development projects (scenarios) to be explored in terms of their ecological and social impacts, not just the three created in the project. The DSS will reside with OKACOM.

The scenarios predicted how the situation could change for eight sites along the river system, each of which represented longer stretches of the system and the social areas linked to it.

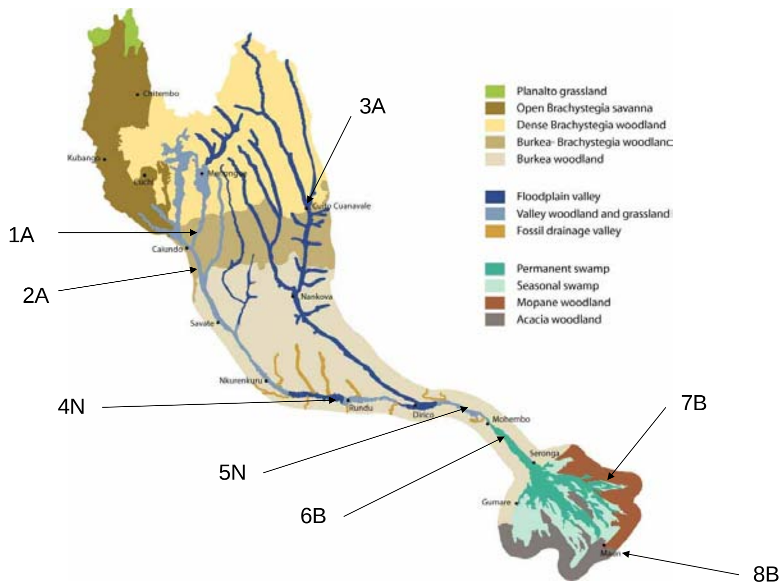

Figure 1. Location of the eight representative sites: three in Angola (marked A), two in Namibia (N) and three in Botswana (B). Map from Mendelsohn and el Obeid (2004).

The predictions covered changes in the following:

- the flow regime
- the river ecosystem
- the socio-economic situation of people using the river's natural resources
- the macro-economic situation.

Changes in the flow regime

The hydrological models set up as part of the EPSMO project simulated possible flows at each of the eight sites under each scenario. These data were converted into several sets of summary flow statistics that were relevant for the health of the ecosystem. Figure 2, by example, shows how the flood season would shrink and the dry season grow in duration under the three scenarios.

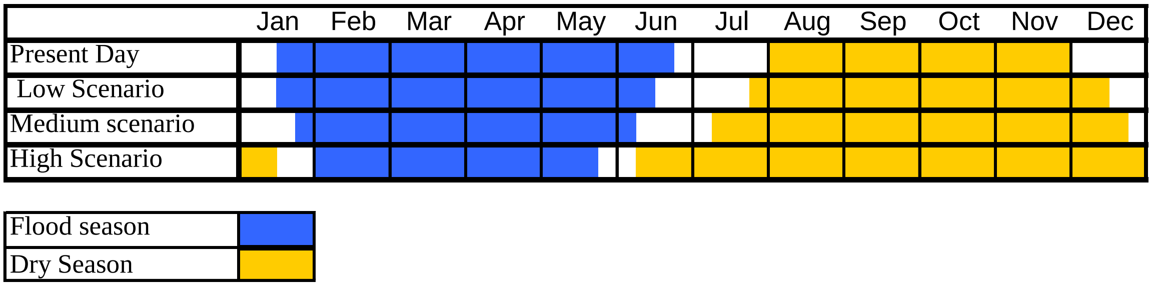

Figure 2 Changes in onset and duration of dry and flood seasons at Popa Falls (Site 5) and the Panhandle (Site 6) under different scenarios. White areas are times of transitional flow between flood and dry seasons.

Figure 2 does not show how the size of the flows might also change, but this can be gleaned from individual tables of other summary statistics. Table 3, for instance, details how the minimum flows in the dry season could change. Sites 5 and 6 would again be heavily impacted, with flows falling to 18% of Present Day under the High Scenario.

Table 3 Dry season minimum flow ($m^3 s^{-1}$). PD = Present Day

Site	PD	Low	Medium	High	Comment
1	12	0.4	0.3	0.3	All Scenarios similar. Drastic drop from PD
2	32	16	12	24	Minimum flow drops to 50% (L), 38% (M) of PD and then under H increases to 75% because of dam releases in dry season
4	35	20	15	19	Decline through L and M to 43% of PD then increase for H to 54%
5/6	114	101	93	21	Progressive decline from PD to very large drop for H: 89%, 82%, 18%

Changes in the river ecosystem

The kinds of flow changes described above would trigger changes in the river ecosystem. These were predicted using more than 70 indicators that were grouped into the following major parts of the ecosystem:

- channel form
- water quality
- vegetation
- aquatic invertebrates
- fish
- river-dependent terrestrial wildlife
- water birds.

The project produced a DSS that predicted the degree of change in each of these indicators with each scenario. These predictions were combined into summaries of ecosystem health, in other words, predictions of how well the river would still be able to provide ecosystem services under the three possible levels of development. A common scoring system in this kind of work is from A to F, where A is a natural, unmodified system and F is a critically modified system that can no longer produce historical ecosystem services and thus may have little value for people. A general aim among countries using such a system could be to not let any rivers fall below a D category and to keep most well above that, with those of conservation value at an A, B or high C. In the basin graphic of ecosystem health (Figure 3) rivers depicted in black had no representative sites and so were not included in the assessment. Those coloured blue were predicted to retain their present-day B status, whilst the remainder declined to a C (green), D (orange) or E (red). The sections most under threat are shown with red flags, because they would be unable to sustain present beneficial uses of the system.

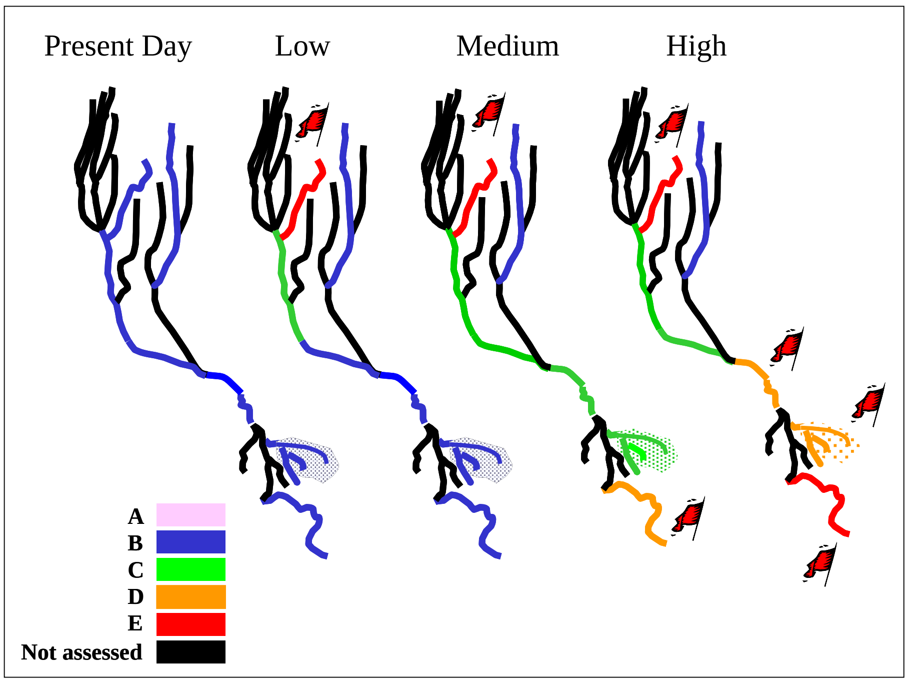

Figure 3 Summary of expected changes in ecosystem health for the Low, Medium and High scenarios.

If the developments mentioned in Box 1 were to be constructed with their assumed design and operating rules then three main predicted trends are clear.

1. A progressive decline in condition of the river ecosystem would occur from the Low to High Scenarios, with the High Scenario rendering large parts of the system unable to sustain present beneficial uses and causing significant drying out of the Delta.
2. A severe impact in an upper-basin tributary would be localised around Capico (Low Scenario) until it, together with further downstream developments, triggered a widespread decline in the middle reaches to condition C (Medium Scenario).
3. Transboundary impacts would be felt first and most severely in the Delta and its outflow.

All the predicted river changes are likely to have been underestimated because they do not include impacts not associated with flow manipulations, such as point and non-point pollution, dredging, riparian clearance and so on. It is clear that the level of development represented by the High Scenario would have a significant impact on this river system and severely reduce the services it presently provides.

Changes in the socio-economic situation of people using the river's natural resources

Short-term livelihood implications

Many of the changes in the river ecosystem translate into impacts on the livelihoods and welfare of the basin's people and on national economies. As a first statement of these impacts, the ecosystem changes were applied to enterprise models that measure private net incomes (livelihoods) and economic national income (economic contribution).

At the basin level, the livelihoods value would drop from the Present Day estimate of US$ 60 million per year, to less US$ 10 million per year for both the Medium and High water-use scenarios (Figure 4).

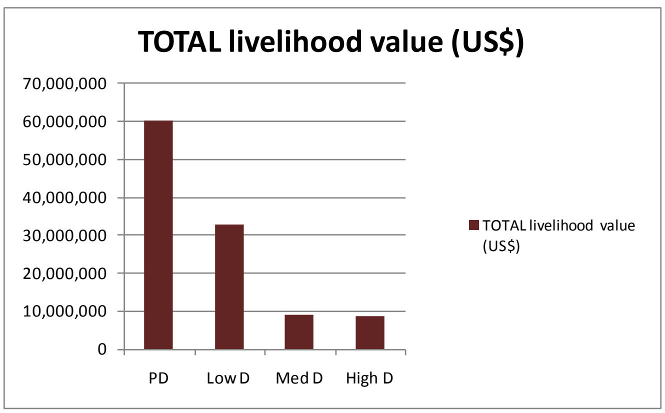

Figure 4 The short-term implications of water-use scenarios for livelihoods in the Okavango River Basin. Present Day (PD), Low Development (Low D), Medium Development (Med D) and High Development (High D) (US$, 2008)

These predicted changes can be scaled up to economic national incomes as shown in Figure 5, combined for the basin as a whole. Direct economic contribution to the national income provides a better measure than household net income of the real impact on socio-economic welfare. [1] This variable shows a decline from US$ 100 million per year to less than US$ 10 million per year for the Medium and High development scenarios.

[1] Direct contribution is a comprehensive measure that includes the basin household net income, as well as the income to other basin investors, and stakeholders.

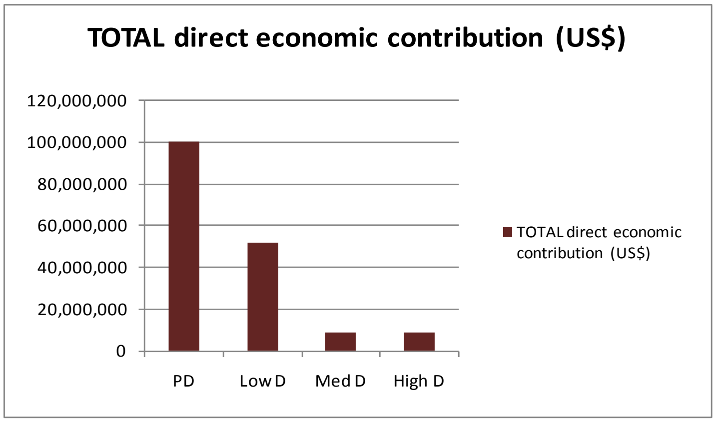

Figure 5 The short-term implications of water-use scenarios for direct economic income in the Okavango River Basin. Present day (PD), Low development (Low D), Medium development (Med D) and High development (High D) (US$, 2008)

The significant declines in both these indicators through the water-use scenarios are primarily linked to declines in tourism. Relatively small, sustained reductions in tourism demand would severely reduce livelihood values and economic contributions to national incomes.

Long-term livelihood implications

People and societies adapt to change if they can, although with high levels of poverty and vulnerability adaptation can be both risky and costly if indeed it is possible. When the predicted river changes in natural resources were assessed with possible adaptations by people included, then the overall impacts scenarios that emerge are probably more realistic.

Over the Basin, losses in Botswana dominate the picture (Table 4). The negative impacts of the Low Scenario would be moderate, but those of the Medium and High Scenarios would be very significant (Figure 6).

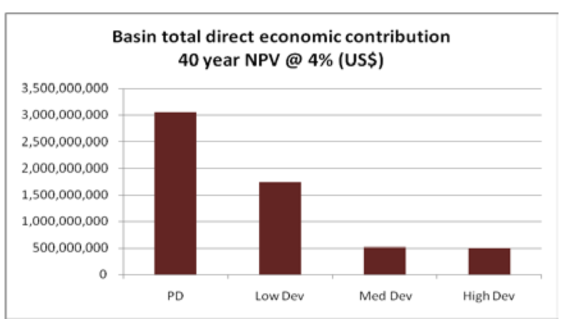

Figure 6 Effect of the three water-use scenarios on direct economic contribution of all riverine natural resource use in the Okavango River Basin. Present day (PD), Low Scenario (Low Dev), Medium Scenario (Med Dev) and High Scenario (High Dev) water use

Table 4 Effect of the Low, Medium and High water-use scenarios on the 40-year net present values (NPVs) attributable to river/floodplain natural resource use in the whole Okavango River Basin

OKAVANGO BASIN	Present day	Low Development	Med Development	High Development
Net present value @ 4%	(US$, 2008)			
Tourism sector	1,989,596,200	1,089,222,700	199,104,700	206,341,600
Rural household sector	1,057,568,000	646,941,500	316,064,000	295,715,900
TOTAL resource use	3,047,164,200	1,736,164,100	515,168,700	502,057,500
• Fish use	125,905,100	75,448,600	69,065,500	64,537,400
• Floodplain reeds use	39,722,500	36,385,300	36,221,900	36,248,100
• Floodplain grass use	99,901,600	92,956,800	91,953,300	92,932,800
• Floodplain gardens	6,712,800	7,362,300	7,278,200	7,399,200
• Floodplain grazing	10,752,600	9,115,000	8,864,900	11,046,700
• Tourism wages	774,573,400	425,673,400	102,680,300	83,551,800
Losses from present day				
Tourism sector		900,373,500	1,740,491,500	1,783,254,600
Rural household sector		410,626,600	741,504,000	761,852,100
TOTAL resource use		1,311,000,100	2,531,995,500	2,545,106,700
• Fish use		50,456,500	56,839,600	61,367,700
• Floodplain reeds use		3,337,100	3,500,600	3,474,400
• Floodplain grass use		6,944,800	7,948,300	6,968,800
• Floodplain gardens		(649,400)	(565,300)	(686,400)
• Floodplain grazing		1,637,600	1,887,700	(294,100)
• Tourism wages		348,900,000	671,893,100	691,021,600

The results suggest that the levels of water developments represented by the three scenarios would significantly reduce the income that people in the basin and in the broader economies derive from the river. For the Medium and High Scenarios, the aggregate losses would be lowest in Angola, at about US$ 65 million and five times greater in Namibia at about US$ 330 million. Such losses would be 30 times greater in Botswana than in Angola, at around US$ 2.1 billion.

These losses would be felt differently at the household level in the three countries. Within the socially defined areas linked to the river, Angolans derive 19% of their total household income from it, Namibians 32% and Botswanans 45%. With the predicted changes in the river, the percentage of their annual income that they might lose ranges from 8% to 39%, with a basin average of about 20% loss under the Medium and High Scenarios.

These aggregate losses will impact on basin populations that are already poor and vulnerable relative to the broader populations of their countries. As the losses are likely to be greater for the tourism industry than for the rural household sector, the impact on the main income earners in this industry - the investors, owners of capital, government, and employees including wage earners from the rural populations - might be even greater than for the rural population as a whole.

In conclusion, the emerging picture is that the people in the Angolan basin currently derive relatively little income from the river system, while those in the countries downstream, and most notably Botswana, derive considerably more from it. By far the major part of this income is based on the natural status of the river/wetland ecosystem, with tourism making up the bulk of this. Botswana has invested in this natural system through land allocation and protection, and relies on it for the bulk of its basin economy.

Changes in the macro-economic situation

A macro-economic trade-off analysis showed the potential basin-wide economic consequences of the three water-use scenarios. It groups the existing natural resource and tourism benefits from the basin as ecosystem services, and the water supply and sanitation, irrigation and hydropower values as water-resource developments. It does not include all ecosystem services (Table 1), but relates principally to the provisioning services and some cultural services. It thus underestimates the total value of ecosystem services provided by the river and consequently underestimates the potential negative economic impacts of the three scenarios.

From a basin perspective, the potential large ecosystem losses faced by the downstream riparian countries would be from US$ 700 million for the Low Scenario through to US$ 1.4 billion for the Medium and High Scenarios. In effect, both the Medium and High Scenarios generate such a magnitude of ecological economic losses that they would overwhelm all the benefits of the water-resource developments they represent. This is the case even under an optimistic economic projection. From a basin-wide perspective then, caution (Box 2) and further study is called for before proceeding with any of the proposed scenarios given that the developments they represent might not produce “optimistic” results (collectively or individually), and given the now-documented risk that such developments would result in substantial economic losses in terms of ecosystem services.

Despite this overall note of caution, the analysis does clarify a few key findings that could be considered in future development planning.

- The provision of improved *urban water supply and sanitation* requires relatively small amounts of water to be extracted from the system, and therefore may be judged and promoted based on the contribution to human well-being and socio-economic development (and not linked to the loss of ecosystem services) within the scope of national development plans and budgets. This is with the proviso that effluents from such schemes are treated to a high standard before return to the river.
- The *hydropower schemes* considered are run-of-river and will not necessarily have a significant impact on downstream ecosystems (depending on their design and operation)

and, therefore, may be considered purely within the context of the planned development of the Angolan and Namibian power sector plans (and not linked to the loss of ecosystem services). This is with the proviso that no major storage occurs and sediment and fish movement along the rivers past such schemes is resolved.

- The cumulative impact of the *irrigation schemes* suggested under the Medium and High Scenarios is the major reason for the vast majority of the economic losses in terms of ecosystem services. For this reason it may be best to contemplate only limited development of economically sound irrigation projects while simultaneously exploring further development of realistic alternative sources of income generation that are low in water use – such as wildlife and tourism.

Box 2 The Cuito River

The Okavango River system has floodplains that store floodwaters and sustain the river in the dry season. If they were diminished, there would be increased flooding downstream and a significant drying out of the Delta and its outflow due to the weakening of dry-season flows. The Cuito River is key to the functioning of the whole lower river system, because of its strong year-round flow, its wet-season storage of floodwaters on vast floodplains and the gradual release of water back into the river in the dry season. The riverine ecosystems and associated social structures of people along the lower Okavango River, the Okavango Delta and the outflowing Thalamakana and Boteti Rivers are sustained mostly by the annual flow regime of the Cuito. If these areas are of concern at the basin level, then water-resource development along the Cuito, or intervention in the functioning of its floodplains, should be modest and undertaken with extreme caution.

A promising future economic path for the basin would be one of low water use and continuance of the existing water economy that supports important ecosystem services. This would need careful planning, not least because of the present asymmetry in levels of development and economic opportunity between riparian countries.

3. Considerations for basin planning: the concept of Development Space

The Flow Assessment done within the EPSMO project produced scenarios that describe possible pathways into the future: multi-faceted views of potential changes in the river, the social structure of its people and both local and national economies. Providing both sides of the development picture in this way, for discussion and negotiation by stakeholders, adheres to the principles of Integrated Water Resource Management (IWRM).

To help stakeholders use the scenarios and the governments make decisions on basin development, the concept of Development Space could be useful (Figure 7). This is based on the certainty that as river flows are modified then the natural attributes of the river ecosystem will change. The Development Space may be defined as the difference between current conditions in the basin and the furthest level of development found acceptable to stakeholders through consideration of the scenarios. Beyond this point, costs would be perceived to outweigh the benefits of development (cf Table 2). The scenarios produced (the arrows in Figure 7) lie at points along the development spectrum. Their position is not presently known because the governments and their stakeholders would first have to identify the point of unacceptable change.

We do not know at the moment if one or more of the Low, Medium, or High Scenarios represent unacceptable change. The answer to this is not gleaned from science, but rather it is a value judgement by society. To identify this point, the governments and their stakeholders could ask themselves what they would consider to be unacceptable, what would be their 'mark in the sand', and then check which of the scenarios illustrate this in order to identify unacceptable ones. Could their mark in the sand be, for instance:

- parts of the channel drying out seasonally?
- Floodplains no longer flooding?
- Water too polluted to drink or wash in?
- 30% loss of biodiversity?
- 60% loss of fisheries?
- Loss of areas of religious significance?
- Or what?

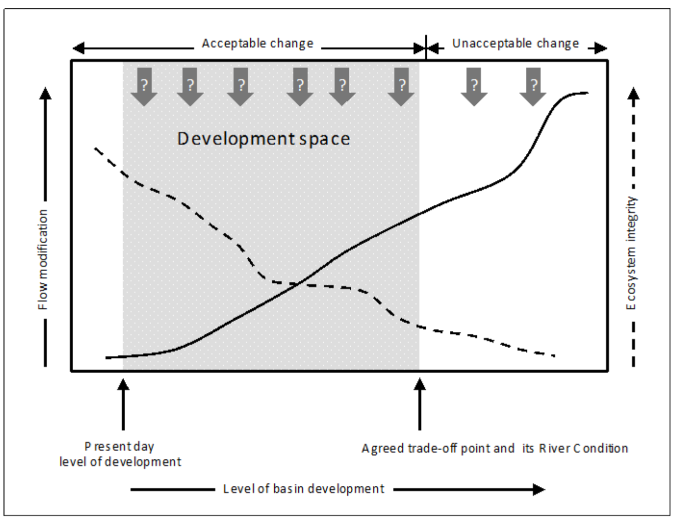

Figure 7 The concept of Development Space, which is defined by Present Day conditions and the negotiated limit of ecosystem degradation as basin development proceeds. Arrows with question marks represent the possible positions of the three scenarios.

Different stakeholders, such as conservation agencies and agriculture, might identify different acceptable end points, and it is the task of governments to take the final decision. If that decision shows that the point of unacceptable change lies to the right of Present Day then there is, according to the stakeholders, Development Space remaining in the Basin. If it lies to the left, then unacceptable change has already happened and rehabilitation that includes reversing some flow modification could be considered. If necessary, more scenarios could be created by the EPSMO Decision Support System in order to hone in on the point of unacceptable change.

If the Okavango countries were willing to identify the Development Space in this way, then theoretically they could then divide this Space between them through negotiation. If each country has its Development Space, then some countries could develop more slowly, knowing that their share of the water awaits them as needed. Other countries could develop in ways that do not require much water, thereby choosing to use their share of the Space to maintain the river condition at a higher level than the point of unacceptable change. This apparently is not how international water law views the sharing of rivers, where present needs take priority and future needs cannot be reserved but, from the perspective of sustainability, that approach is flawed. Unless some limit on river degradation is drawn and people then live within that limit, development cannot claim to be sustainable. For truly sustainable development, it is suggested that development planning should start at the opposite end to present, that is, to first identify and agree on the point beyond which ecosystem degradation should not be allowed to proceed and then to work backwards, considering how to live and share within those limits.

4. Strengthening the Knowledge Base and capacity building

The EPSMO Flow Assessment and TDA were based mostly on best available information, international knowledge and local wisdom, with very few new data collected. The resulting scenarios provided the best predictions currently possible of the future consequences of a range of possible water-resource developments, but their level of confidence needs enhancement.

A directed and carefully planned programme of basin-wide research, together with technical development within OKACOM, is imperative to firm up the predictions and produce further scenarios as desired by the countries. This could be done in a way that builds facilities and capacity within the countries and OKACOM as they move toward a negotiated basin plan. The EPSMO project has provided a solid basis for applying for future international funds, and its Strategic Action Programme (SAP) captures in general terms how the process could be taken forward, but the details would need careful alignment with OKACOM'S needs. . Ensuring appropriate Terms of Reference for any of the work would be critically important, or time and money could be wasted.

Technical specialists experienced in river basin management know what actions can be effective and which do not work, how long specific activities take, how liaison with research groups and stakeholders can best be used, and the sequence of steps for implementation of a more sustainable approach to river-flow management. It is recommended that OKACOM employs a small team of scientific advisors (an Expert Panel) that could help it develop suitable TORs and monitor the quality and relevance of the work then done.