

Republic of Namibia
Ministry of Land Reform

**Valuation of Ecosystem Services for the**

**Strategic Environmental Assessment (SEA)
of the Zambezi Integrated Regional Land Use Plan**

**Final Report**

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**compiled by**

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Abbreviations

ABS Access and Benefit Sharing Protocol of the CBD

CBD UN Convention on Biological Diversity

CBNRM community-based natural resource management

ES ecosystem service

FMD foot-and-mouth disease

GNI Gross National Income

HWC human wildlife conflict

KA Kyaramacan Association

MAWF Ministry of Agriculture, Water and Fisheries

MET Ministry of Environment and Tourism

MEWT Botswana Ministry of Environment, Wildlife and Tourism

MFMR Ministry of Fisheries and Marine Resources

NACSO Namibian Association of CBNRM Support Organisations

NNI Net National Income

NTB Namibia Tourism Board

PA protected area

PCLD Programme for Communal Land Development

SAM social accounting matrix

TEV Total Economic Value

# Introduction

The Strategic Environmental Assessment of the Zambezi Integrated Regional Land Use Plan was complemented with an assessment of the value of the Ecosystem Services in the region. This was to add additional information to the SEA through providing estimates of the importance and values of the identified ecosystem services, to inform the land use planning process. This report describes the assessment and its results.

##  Objective

The objective was to estimate the importance and where possible, values of ecosystem services across the Zambezi Region, focusing on four sub-regions:

* the Kwando Core area and central Bwabwata,
* the Kwando River and floodplains,
* the Mudumu and east Zambezi woodlands, and
* the Zambezi River and floodplains.

These categories represent the two main habitats – woodland and wetland – which are found in Zambezi Region.

Values were to be provided in both monetary and qualitative terms. Resource economists were employed to calculate monetary values, and this was supplemented with values expressed in livelihood terms.

The work was to conclude with lessons on how to incorporate ecosystem services in future IRLUP SEAs.

# Methods

A methodology was suggested by GIZ (Slootweg 2015) to provide a complete overview of ecosystem services, their stakeholders, the quantitative importance, and the development opportunities or constraints they present. This nine-step process is described in the table below, with an explanation of how each step was carried out.

**Table 1. Methodology followed to carry out the ecosystem services valuation assessment.**

| **Step** | **Implementation**  |
| --- | --- |
| 1. | Define boundaries | The boundaries of Zambezi Region are clearly defined and fully understood by all stakeholders. |
| 2.  | Identify and map ecosystems | Two main ecosystems were recognised; woodlands and wetlands. These are shown in Figure 1. The western wetlands of the Kwando+Linyanti system are continuous with the eastern wetlands of the Chobe+Zambezi River system, without a clear boundary separating them. It was agreed that Lake Liambezi should be grouped with the Chobe River, with the separation between the eastern and western wetlands lying immediately west of Lake Liambezi. The woodlands were divided into western and eastern components, based on their administrative status. The woodlands west of the Kwando River fall within the Bwabwata National Park, and experience very little utilisation. To the east of the Kwando River, the woodlands are made up of communal land (including Conservancies and Community Forests), State Forest and the Mudumu National Park. This area is more densely settled and experiences much greater exploitation by people than the western woodlands. Even though there are different vegetation categories (e.g. mopane woodland, Kalahari woodland), they provide roughly similar services. |
| 3.  | Describe potential linkages with neighbouring areas | Movements of animals, people and nutrients from one ecosystem to the other were recognised in the discussions. Where possible, these are reflected qualitatively in the valuations.  |
| 4.  | Identify and quantify ecosystem services for each ecosystem | A group of ecologists and people familiar with Zambezi Region (listed in Appendix A) were brought together in a specialist workshop to advise on the ecosystem services. The two-day workshop was held on 3-4 July 2014. Participants included the resource economist so that he could advise on valuation aspects. This method was very constructive and helpful in identifying sources of data and considering how proxy data could be used where local reliable information was missing. In addition, three members of the SEA team (Mr Beaven Munali [local Zambezi representative], Ms Dorotea Nakatana [assistant], and Mr John Pallett [SEA project leader]) spent five days in Zambezi Region, on 20 – 25 July 2014. This focused on interviewing natural resource users to canvas their opinions on ecosystem services. This allowed the information from the workshop to be ‘ground truthed’ and put into context. Stakeholders interviewed during the field work are listed in Appendix B.The various ecosystem services provided by each ecosystem are described in Tables 2 - 5. |
| 5.  | Identify groups of stakeholders for each service | Experts in the workshop were able to identify the main user groups for each service that was identified. Field work helped to confirm these groups. They are described in Tables 2 - 5. |
| 6.  | Quantify value for each group of stakeholders | This was attempted in the workshop, but there was generally insufficient data to assign values for particular groups of people. Also, interviewees in the field were mostly unable to provide data on the actual monetary values of services they described. Most of this information was therefore qualitative only.  |
| 7.  | Baseline situation and trend for each service | The state of each resource or service, and the trend in its use, is summarized in Tables 2 - 5.  |
| 8.  | Suggestions for regulatory or policy adjustments  | These are noted in Tables 2 - 5.  |
| 9.  | Gaps in information | Many gaps were identified, both in the ecosystem information, and in the availability of economic data. Some proxy information (e.g. from the Okavango Swamps) was used.  |

# Ecosystems in Zambezi Region

The main ecosystems or habitats in Zambezi Region, woodland and wetland, are shown in Figure 1.



Figure 1. Delineation of woodland and wetland ecosystems in Zambezi Region. Woodlands include the habitats shown as Kalahari woodlands, mopane woodlands, riverine woodlands, and the small Impalila Island. Wetlands collectively refer to rivers and open water, as well as floodplains.

##  Woodlands

Zambezi Region is part of an extensive landscape of broad-leafed woodland on sandy soils of the Kalahari Basin. These woodlands can be described as tree savanna dominated by a few large tree species, with varying amounts of lower bushy and scrubby growth, and a grassy layer. They are divided into three main types, based on the dominant tree species and their habitat associations.

The vegetation type referred to as Kalahari woodland predominates in the western and northern parts of the region. The main dominant trees include kiaat (*Pterocarpus angolensis*), burkea (*Burkea africana)*, false mopane (*Guibourtia coleosperma*), mangetti (*Schinziophyton rautanenii*) and silver Terminalia (*Terminalia sericea*). For the purpose of this study we separate the western woodlands, forming part of the Bwabwata National Park, as a distinct unit, as this area has a distinct status as a Protected Area. Besides the area being used for conservation and tourism, the land is utilized almost solely by the San people who live at a few settlements in the Park.

Mopane woodland, that is dominated by one species, mopane (*Coleospermum mopane*), is found mainly in the central part of eastern Zambezi. In this study, this ecosystem is combined with the Kalahari woodland that is mostly north of the main Kongola – Katima road, as the main users – the conservancies and livestock farmers in eastern Zambezi Region – derive similar benefits from both Kalahari and mopane woodlands.

Riverine woodlands occur in patches on the banks of the rivers. This habitat is now rare as the tall and dense trees have mostly been cut down. Remaining patches are concentrated along the Kwando River and in the Maningimanzi area east of Katima Mulilo. The vegetation is dominated by silver terminalia (*Terminalia sericea)*, African mangosteen (*Garcinia livingstonei),* water-pear *(Syzigium guineense),* sausage tree *(Kigelia africana)* and Natal mahogany (*Trichilia emetica)*. This vegetation type includes the distinctive Impalila woodland at the far eastern extremity of the region, where the rich soil and surface basalt rocks, with a mosaic of river channels and dryland, host a diversity of plants, many of which occur nowhere else in Namibia.

The variations in dominant species and the overall composition of the vegetation community are determined by the texture and depth of soil, the nutrient content, the concentrations of salts and the ability to hold water (Mendelsohn & Roberts, 1997). Water drains through sand easily, washing nutrients away and leaving both the sands and many grasses low in nutrients. Thus the woodlands are relatively nutrient-poor, with slight improvements in fertility in low-lying areas with slightly more clay content and organic matter.

##  Wetlands

The rivers of Zambezi Region make up part of the Zambezi River basin and they are interconnected in a complex fashion, due to the flat landscape. The main channels of the rivers carry water permanently, but they also spill their banks seasonally, flooding large areas and forming extensive marshes and floodplains that are only seasonally wet.

The main branch of the Zambezi River, in this section, has a mean annual runoff of about 40,000 Mm3/a (measured at Victoria Falls, Schlettwein 1990). High water at Katima Mulilo is usually in March, April and May, and the flood period typically lasts 4-6 weeks, when water spreads out over much of the eastern part of the Region. The floodplains remain inundated for longer periods, and support vast beds of papyrus and reeds in a maze of small channels and islands.

The Chobe Marsh stays permanently wet from water backing up along its course from the Zambezi River, or from outflow from the Linyanti Swamp and Lake Liambezi.

The Kwando River is a much smaller system, with mean annual runoff about 1,200 Mm3/a (less than 3% of the Zambezi River volume). It is linked to the Zambezi River via the Linyanti Swamp, Lake Liambezi and the Chobe River which joins the Zambezi River at Kazungula. When the Kwando River is in flood, water pushes towards the Zambezi. When the Zambezi is in flood, the flow is reversed and water is pushed up the Chobe to Lake Liambezi. This ephemeral lake dries out for long periods (e.g. from 1985 to 2002), during which time it is farmed, capitalizing on the peat-rich soil . Currently, it has held water since 2003.

The eastern floodplains are thus only intermittently inundated, while the Zambezi and Kwando Rivers, Linyanti Swamp and Chobe Marsh are permanent features. Flow rates in these rivers are extremely slow as the water has to percolate through extensive reed swamps. The floodplains consist of reedbeds and open flooded grasslands, with higher, drier areas supporting grasses and trees, and lower, wetter areas marked by dense tall reeds, sedges and papyrus beds. In places there are wide lawns of the grass *Cynodon dactylon*.

In this study, the wetlands are separated into eastern and western parts, since the eastern part experiences considerably more water and flooding is much more extensive, which gives rise to a rather distinct set of ecosystem services. Although the wetlands are all joined to each other, the dividing line between eastern and western parts is set as immediately west of Lake Liambezi.

# Ecosystem services

‘Ecosystem services’ are defined broadly as any goods and services that are derived from the natural ecosystem. They can be thought of as all renewable resources and the ecological processes that sustain human life in a particular area.

The ecosystem services are categorized into three main types, namely provisioning, regulatory and cultural. We concentrated the valuation work on provisioning services, as these are most easily recognized and it was possible to assign monetary values to some of them. Regulatory and cultural services are rather more difficult to assign monetary values, so these have been valued mostly in qualitative terms. The main services are briefly described below.

**Provisioning services**

* Livestock grazing
* Soils and crops
* Game
* Veld foods and medicines
* Fish
* Fuel and energy
* Construction materials
* Crafts
* Water

**Regulatory and supporting services**

* Air quality
* Climate regulation
* Erosion control
* Soil formation
* Nutrient cycling
* Water quality regulation
* Disease control
* Pollination
* Natural hazard regulation

**Cultural and wellness services**

* Cultural and spiritual traditions
* Tourism and recreation
* Aesthetic appreciation and sense of place
* Employment and business
* Climate change resilience
* Science and education

The ecosystem services for each of the four ecosystems are described in Tables 2 – 5. Below are notes that refer to the content of the tables.

**Beneficiaries**

‘Local people’ refers to people who live and work in the area. This includes families who have a homestead in the Region but who also derive income from other sources such as family members who live elsewhere in Namibia and send money home. Beneficiaries further afield were categorized as national (occurring in Namibia), and outsiders (mostly from neighbouring countries such as Zambia, Botswana, Congo).

Where possible, specific users are noted, such as lodges, or foreign workers (notably Far-East nationals, who have a growing presence in the Region).

**Value**

Monetary values are derived from the resource economics input, which is described in Appendix C.

**Current status of ES, and trends of ES use and value**

Expert opinions during the workshop, and discussions with stakeholders in the Region, were used to judge the ‘health’ of the ecosystem goods and services, and the trend in their use.

**Opportunities and synergies**

In order to be a useful addition to land use planning, it helps to show where ecosystem goods and services can be utilized for the benefit of development. For instance, the fishing sector is experiencing over-exploitation, but a possible opportunity lies in using specific habitats and the high breeding potential of fish for fish farming (under certain specific conditions based on economic viability).

**Threats and antagonisms**

This refers to human activities and developments, which threaten an ecosystem service. Climate change is likely to threaten many ecosystem services.

**Key drivers of change in the ecosystem service and its use**

In almost all cases, the key driver of change in an ecosystem service is population growth. This is stated, and where more specific forces arise from that, they are described.

**Policy adjustments**

The experts in the workshop gave suggestions on what policies or laws needed to be adjusted so that benefits arising from ecosystem services could be achieved.

**Table 2: Ecosystem services in the western woodlands of Zambezi Region**

|  |
| --- |
| **Woodlands in Kwando Core Conservation area and Central Bwabwata (Kalahari woodland, riparian woodland along Kwando River)** |
| **Provisioning Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Livestock grazing | Local people engaged mostly in subsistence farming. | NNI from livestock grazing estimated at $N0.18 million p.a. | Healthy, but with fluctuations depending on dry spells and fires. | Stable. There is relatively little use of pastures by livestock, since the San keep few cattle. This is part of Bwabwata National Park and the de facto GRN policy in this area is that local communities may keep small numbers of livestock for subsistence purposes.  | In theory, herding of livestock within a National Park can be beneficial from a rangeland health and ecosystem services perspective. This is because cattle are bulk grazers (if herded), and bulk grazing is good for rangelands. There is potential for a more formal integrated rangeland management strategy in the multiple land-use zone of Bwabwata NP.  | Key threats are:- Fires, especially if very frequent (every year) and incorrect timing (early burning is less harmful than late). Most fires are started by people.- Increasing numbers of livestock and wildlife, leading to human-wildlife conflicts.- Politicisation of Bwabwata rangelands by certain traditional leaders.- Increased atmospheric CO2 is known to promote bush growth, so bush encroachment might become more severe. | Key drivers are:- Fires (see previous column)- Increasing numbers of livestock.  | The original intention of this area being mostly a protected park with minimal livestock is changing, with much more livestock occurring in the area. This poses a challenge from the perspective of conservation and tourism on the one hand, and controlling veterinary diseases (e.g. FMD) on the other. A policy decision is needed in this regard. |
| Crops  | Local people | Minimal cultivation is practiced. NNI from crop production estimated at $N1.09 million p.a. | Soil fertility is naturally low, agricultural potential also low considering the low desire by the San to cultivate. ES is healthy but under-utilised.  | Stable | Conservation Agriculture could improve yields, if there is interest.  | Human – wildlife conflict.Drought. Climate change will increase the severity of droughts in future.  | Climate variability, especially prolonged droughts. Conflict mostly arising from elephants raiding crops. | Greater promotion of Conservation Agriculture to improve yields without expanding the development footprint.  |
| Game | Local people from subsistence hunting.Local communities from income from trophy hunting.Trophy hunting industry.Hunters. | Local people – hunt springhares, birds, small antelope. No monetary information available on the value of hunted game to the San in Bwabwata NP. San heavily dependent on veld foods. NNI from trophy hunting estimated at $N4.23 million p.a.Poaching – no information available. | Healthy, but some species being over-exploited e.g. springhares.  | Stable | Improve access to trophy hunting and greater income to Kyaramacan Association. | Lack of access to resources in Kwando Core Area. Global resistance to hunting could jeopardise this income stream. Poaching – a growing problem, usually targeting elephants. It causes MET to reduce the legal offtake of elephants.The nature of poaching has changed – large animals are killed, then additional damage is done by using poison to kill vultures to reduce detection by authorities.  | Population growth is expected to lead to more illegal offtake by outsiders.An international ban on hunting, if it was implemented, would severely reduce this ecosystem service and its benefits to locals and other sectors.  | MET policy for Bwabwata should increase user rights for local people.  |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Veld foods | Local people for subsistence purposes. | Wide diversity of plants used for foods and medicinal purposes. No information on monetary values. But there is strong dependence on these resources for food and health requirements by San people.  | Healthy | Stable | Skills of San people for harvesting veld products, finding water in underground tubers, making fire etc, could be used for cultural tourism.  | None. | None identified. | MET policy for Bwabwata should increase user rights for local people, particularly into the Kwando Core Area. |
| Medicinal plants | Local people.Traditional healers.International – export of devil’s claw as arthritis remedy.  | Estimated N$20 – 30 million p.a. from entire Namibia, which is mostly from devil’s claw.Household health benefit for San not quantified, but it is substantial.  | Probably stable. Devil’s claw likely to become over-exploited as need for rural income grows. | Stable, but harvesting of devil’s claw is increasing, with concern about unsustainable methods of harvesting. | Commercialisation and greater value-adding of Indigenous Natural Products would be beneficial. Also, improved equity in the distribution of benefits from INPs is needed.  | Increasing exploitation of devil’s claw by outsiders, and sale of inferior species of devil’s claw from Zambia, could threaten the market. | Dependence on the international market for devil’s claw.  | MET policy for Bwabwata should increase user rights for local people.  |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Fuel and energy | Local people | NNI from fuelwood estimated at $N0.89 million p.a. | Heathy | Stable | None | Uncontrolled wildfires | Population growth, with its consequence of greater incidence of fires. | A fire policy is in place. |
| Construction materials and implements  | Local people. | Collection of resources is permitted within the National Park but not within the Kwando Core Area. | Healthy | Stable  | Promotion of improved management, harvesting and marketing of thatching grass for high-end construction projects e.g. tourism lodges.  | Fire.Illegal harvesting. | Population growth as a driver of illegal harvesting, and leading to increased incidence of fires.  | Timber harvesting needs improved monitoring and law enforcement. |
| Crafts | Local people | No monetary value calculated. There is relatively little craft production in this area, compared to other parts of Zambezi Region. | Healthy | Stable. | Production of crafts for the tourism sector would benefit local people.  | None identified. | None identified, since there is very little use of this ES.  | No suggestions.  |
| Water | Local people – groundwater. | No monetary value calculated. Settlements such as Mashambo rely entirely on groundwater.  | Healthy. | Stable. | None | No threats known. Consumption is relatively low, aquifer reserves not known to be limited.  | Population growth might increase consumption to a level where sustainability is an issue. | None required at present.  |
| **Regulatory and Supporting Services** |
| Air quality | Local people | No information available for Zambezi Region. Indirect and option values unknown. | Healthy. Veld fires cause some pollution but their impact is temporary and not severe, although it obviously does add unnecessarily to CO2 in the atmosphere. | Stable | None identified | Climate change, with increasing severity of dry spells, could cause fires to be more destructive. | Population growth, which will cause fires to become more frequent. Climate change will possibly cause fires to be more intense in future. | None suggested. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Climate regulation (by sequestration of carbon in woodland trees) | Local peopleAll resident plant and animal life.Worldwide benefit by C sequestration. | No monetary information available. Estimates for carbon sequestration in the Okavango Delta Ramsar site: P28.42/ha. [approx. N$24.48/ha][[1]](#footnote-1) Above ground carbon value of Kiaat (*Pterocarpus angolensis*) trees only, Kavango region, Namibia: N$123.61/tree.[[2]](#footnote-2) | Healthy | Stable | None identified. | None identified.  | Wood harvesting. The level of illegal harvesting is not known, but thought to be low in this part of Zambezi Region which is quite remote, far from urban centres.  | None suggested. |
| Erosion control (by presence of grasses and trees as ground cover)Soil formation (by chemical weathering – probably even slower than typical, due to predominantly quartzitic sandy soils and dry climate)Nutrient cycling (predominantly through trees, providing most of the organic matter that is cycled) | Local people. All resident plants and animals. | No monetary information available. Indirect and option values unknown. | Healthy. The rangelands are not badly degraded by overgrazing. Fires probably do the worst damage, and will temporarily impact on the rate of nutrient cycling.  | Stable | None identified. | There are no known threats to the rangelands and the regulatory services they provide, except for the negative impacts of fires. | Population growth and climate change, causing more intense fires. | None suggested. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Disease control | The whole of Namibia that lies to the west of the Okavango River, which benefits by staying relatively FMD-free due to the ‘buffer zone’ between the FMD-endemic part of Namibia to the east, and the main cattle farming areas to the west. | No monetary information available. But the value of maintaining a disease-free status (especially for meat exports to Europe) for most of Namibia’s livestock is considerable – approx. N$2 billion p.a.  | Relatively healthy, but being threatened by people from Kavango and north-central regions illegally creating cattle posts in Bwabwata NP.  | Stable, but this status liable to be lost if encroachment of cattle posts from the west continues.  | None identified. | As described in column 4, the separation of livestock between Zambezi Region and the rest of Namibia is becoming less clear. | Population growth. | Enforcement of the Bwabwata NP as being relatively free of livestock should be improved.  |
| Pollination | Local people, who rely on bees and indigenous insects for this service | No monetary information available for Zambezi Region.  | Healthy | Stable | Bee-keeping for honey production helps to supplement rural incomes in conservancies. This practice could be greatly expanded.  | None identified.Pests and diseases of bees are a possible threat.Fires possibly reduce plant food availability for pollinators, causing temporary population fluctuations.  | No major changes apparent or anticipated.Increased frequency of fires started by people could be a problem in future. | None suggested. |
| **Cultural, Livelihood and Wellness Services** |
| Cultural and spiritual | Local people | No information available for Zambezi Region on direct, option or non-use values | Healthy | Stable | Implementation of the bio-cultural protocol could lead to improved understanding of the ecosystem services and benefits that local people derive.  | Loss of traditional knowledge.Inadequate rights over natural resources. | None obvious | Implementation of the Bio-Cultural ProtocolGreater ownership and rights over natural resources. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Tourism & recreation  | Tourism industry | A relatively small component of the tourism value estimated for Kwando River & Floodplains is probably also derived from the woodlands. Option and non-use values are unknown. | Healthy – underdeveloped. Hunting – healthy. | Stable | Local people in Bwabwata have no tourism rights in Kwando triangle. This should be revised. Possibility for new lodges/camps in omarambas. | Global resistance to hunting | Tourism numbers internationally, and numbers visiting Namibia. The political disturbances in CaprivI in the 1990s had a profound impact on local tourism. On a global scale, opposition to hunting is an important determinant for the hunting sector. | Access of local people to tourism rights. |

**Table 3: Ecosystem services derived from eastern Zambezi Region woodlands**

|  |
| --- |
| **Mopane and Kalahari and riverine woodlands in eastern Zambezi Region. Includes Katima Mulilo town, Mudumu National Park, and Sobbe, Bamunu and Salambala Conservancies** |
| **Provisioning Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Livestock grazing | Local people.Beef exported to SA, Zambia, Zimbabwe. (Not accepted by EU due to origin from north of Veterinary Cordon Fence.)  | NNI from livestock grazing (Mudumu & East Zambezi and Kwando River & Floodplains) estimated at $N16.44 million p.a. Strong contribution to status and livelihoods for local cattle farmers. | Some local overgrazing. | Increasing numbers of people, and with them, livestock, is leading to increased exploitation. | Cattle and wildlife (browsing species such as kudu, impala) complement each other well in the woodlands where there is abundant browse. Improved community-based control over communal grazing.Commodity-Based Trade (see last column). | Diseases (especially Foot-and-Mouth Disease) lead to livestock deaths but their overall impact on total livestock numbers is low. However this limits commercial offtake of cattle so the value derived from cattle is curtailed.  | Population growth, more settlement, more permanent boreholes around which stocking rates are usually too high.  | Commodity-Based Trade (CBT) is being introduced as a way to market meat products safely even if they originate from an FMD area. This needs greater promotion. |
| Crops  | Local people | NNI from crop production (Mudumu & East Zambezi and Kwando River & Floodplains) estimated at $N99.19 million p.a. | Low intrinsic potential due to relatively poor soils, so yields generally low.Soils get locally degraded by practice of slash and burn.  | Stable.  | Conservation agriculture could increase yields.Clustering of agriculture plots would help to improve extension services, and reduce human-wildlife conflict. Assistance to farmers from conservancies, in wildlife-proofing their fields, deserves greater support. | Elephants, hippos, bushpigs and other wildlife pose a threat to crop production. This human-wildlife conflict causes anti-wildlife attitudes but it can be reduced through measures such as chilli-bombs, noisy fences, electric fencing. Escalating slash and burn. | Population growth.Communal land tenure is the main system that allows slash-and-burn farming practices to continue.  | The fundamental issue of communal land tenure needs to be considered with the view towards giving land residents responsibilities and benefits for their land and resources. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Game | Local people | NNI from trophy hunting estimated at $N4.23 million.Value to local people – no monetary information available. Meat from any hunted animal – whether legal or not – makes a valuable contribution to rural livelihoods. Meat from e.g. trophy elephants is greatly appreciated by local communities. Poaching – no information available. | Wildlife numbers stable, some species increasing. | Wildlife populations increasing, especially in parks. | National Parks should serve as refuges for wildlife, to be used for stocking conservancies if and when necessary. Wildlife could become a greater source of protein under good management. Lechwe can tolerate heavy offtake but populations need to increase first to allow this. The ban on hunting in Botswana & Zimbabwe could benefit Namibia where higher offtake (especially elephant) might be justified. | Poaching is a considerable threat. The nature of poaching has changed – large animals are killed, then additional damage is done by using poison to kill vultures to prevent detection by authorities. The global resistance to hunting could negatively affect the harvesting of wildlife by conservancies. Infrastructure development, especially roads, increases public access into remote wildlife areas. Construction camps often a focus of illegal trapping e.g. birds, leguaans, snakes, rodents. | Population growth.Infrastructure development, especially roads | Namibia’s CBNRM policy, which includes benefits to rural communities through hunting quotas, needs to be strongly defended. |
| Veld food | Local people.Devil’s claw discussed in row below.  | Wild food harvest has been estimated in miombo woodlands as 6% of total household income, varying between 2.6 - 6.8%, depending on income quintile.[[3]](#footnote-3) | Healthy | Stable. | Commercialisation of indigenous plant products (e.g. marula, monkey-orange, mangetti nut) could help to increase local values from these plants. However this needs to be carefully managed to prevent over-exploitation and loss of this resource for poor people who depend more heavily on them.  | None identified. | Population growth. | Security of rights over natural resources should be strengthened (e.g. through conservancies)  |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Medicinal plants | Local people.Traditional healers.International – export of devil’s claw as arthritis + rheumatism remedy.  | Estimated N$20 – 30 million p.a. from entire Namibia  | Probably stable. Devil’s claw likely to become over-exploited as need for rural income grows. | Stable, but harvesting of devil’s claw is increasing, with concern about unsustainable methods of harvesting. | Demand for devil’s claw is growing in international markets - raising opportunities for greater rural incomes.  | Increasing exploitation of devil’s claw by outsiders, and sale of inferior species of devil’s claw from Zambia, could threaten the market. | The potential of devil’s claw for commercial marketing opens up the likelihood of over-exploitation. | Conservancies monitor and control harvesting - this must be maintained and strengthened. |
| Fuel and energy  | Local people. | NNI from fuelwood (Mudumu & East Zambezi and Kwando River & Floodplains) estimated at $N81.15 million p.a. | HealthyLocal deforestation is occurring around Katima Mulilo and other towns.  | Stable away from settlements, wood resources being over-exploited near towns.  | None | Uncontrolled wildfires. Significant loss of large trees has occurred in the State Forest, since there is more grass fuel there from the lower level of grazing.Heavy wood harvesting near towns and settlements. | Population growth | Fire management needs much greater priority. This requires collaboration between Community Forests, Directorate of Forestry, Conservancies, MET, Traditional Authorities, and other institutions.  |
| Construction materials and implements  | Local people | NNI from building poles, thatching grass and sawn timber (Mudumu & East Zambezi and Kwando River & Floodplains) estimated at $N10.83 million. | Healthy | Stable  | Conservancies already have management plans – incl. fire management.Use of poles and thatch for housing is aesthetically pleasing, has good thermal properties, and the resources are renewable (in comparison to corrugated iron for example). Lodges recognise this value of ‘traditional African style’. The practice could be increased as long as harvesting rates are controlled. | Fire.Illegal harvesting. | Population growth. | Timber harvesting should be more rigorously controlled.  |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Crafts | Local peopleTourists | NNI estimated for craft production at $N0.13 million p.a.Basketry and woven products from eastern Zambezi are recognised for their fine quality and craftsmanship. This brings income and pride to women involved in these practices. | Healthy  | Stable | Marketing of crafts is done locally and some of the products reach Windhoek outlets. Possibly there is room for more of this, even extending to international markets. | None identified. | Tourism is the main determinant of commercial sales. Marketing plays an important role for local small industries.Transfer of skills is important for the families involved in this trade. | None suggested. Traditional values are upheld in the conservancies, and this should be maintained.  |
| Water | Local people. Groundwater is used, with increasing dependence on piped water.At present there is relatively little use of river water for irrigation. | No value calculated. | Healthy | Stable, but movement of people away from floodplains is putting greater pressure on groundwater resources. Also, possible future irrigation schemes are likely to increase water consumption significantly.  |  |  | Population growth. |  |
| **Regulatory and Supporting Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Air quality | **Local people** | No information available for Zambezi Region. Indirect and option values unknown. | Healthy. Veld fires cause some pollution but their impact is temporary and not severe, although it obviously does add unnecessarily to CO2 in the atmosphere. | Stable | None identified | Climate change, with increasing severity of dry spells, could cause fires to be more destructive. | Population growth, which will cause fires to become more frequent. Climate change will possibly cause fires to be more intense in future. | None suggested. |
| Climate regulation (by sequestration of carbon in woodland trees) | Local peopleAll resident plant and animal life.Worldwide benefit by C sequestration. | No information available for Zambezi Region.Estimates for carbon sequestration in the Okavango Delta Ramsar site: P28.42/ha. [approx. $N24.48/ha][[4]](#footnote-4) Above ground carbon value of Kiaat (*Pterocarpus angolensis*) trees only, Kavango region, Namibia: $N123.61/tree.[[5]](#footnote-5) | Healthy | Stable | None identified. | None identified.  | Wood harvesting. The level of illegal harvesting is not known, but thought to be low in this part of Zambezi Region which is quite remote, far from urban centres.  | None suggested. |
| Erosion control (by presence of grasses and trees as ground cover)Soil formation (by chemical weathering – probably even slower than typical, due to predominantly quartzitic sandy soils and dry climate) | Local people. All resident plants and animals. | No monetary information available. Indirect and option values unknown. | Healthy. The rangelands are not badly degraded by overgrazing.  | Stable | None identified. | There are no known threats to the rangelands and the regulatory services they provide, except for the negative impacts of fires. | Population growth and climate change, causing more intense fires. | None suggested. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Nutrient cycling (predominantly through trees, providing most of the organic matter that is cycled) | Local people.All resident plants and animals. | No monetary information available. | Healthy. The rangelands are not badly degraded by overgrazing. Fires probably do the worst damage, and will temporarily impact on the rate of nutrient cycling.  | Stable | None identified. | Poaching of large animals and poisoning of the carcasses has almost eliminated the Zambezi Region vulture population. Nutrient cycling now probably slower and at a lower level.  | Population growth and climate change, causing more intense fires. | None suggested. |
| Pollination (same as for woodlands in Bwabwata NP) | Local people, who rely on bees and indigenous insects for this service | No monetary information available for Zambezi Region.  | Healthy | Stable | Bee-keeping for honey production helps to supplement rural incomes in conservancies. This practice could be greatly expanded.  | None identified.Pests and diseases of bees are a possible threat.Fires possibly reduce plant food availability for pollinators, causing temporary population fluctuations.  | No major changes apparent or anticipated.Increased frequency of fires started by people could be a problem in future. | None suggested. |
| **Cultural, Livelihood and Wellness Services** |
| Cultural and spiritual  | Local people | No monetary information available for Zambezi Region on direct, option or non-use values. | Healthy | Stable There is a re-emergence of pride in traditional practices as they are being commercially rewarded through tourism.  | Implementation of the bio-cultural protocol could lead to improved understanding of the ecosystem services and benefits that local people derive. Greater awareness of traditional resources (e.g. veld foods) can be achieved by outreach programmes of Community Forests.  | Loss of traditional knowledge.Inadequate rights over natural resources. | Population growth, and gradual uptake of western practices, is likely to reduce traditional practices. But on the other hand, if this is accompanied by greater tourism, then these practices might be retained. | Implementation of the Bio-Cultural ProtocolGreater ownership and rights over natural resources. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Tourism & recreation  | Local people.Tourism industry.Southern African and overseas tourists | NNI from non-consumptive tourism estimated at $N95.56 million p.a.Option and non-use values are unknown. | Healthy – but still underdeveloped.Hunting sector – healthy. | Stable | Wildlife and cattle could be integrated successfully in certain areas – especially in riparian/inland interface.Growing numbers of opportunities linked to tourism e.g. service industries, tour guiding. Katima Mulilo could become a training hub e.g. UNAM.  | Global resistance to hunting. | Global - hunting | Access of local people to tourism rights. |

**Table 4: Ecosystem services derived from the Kwando and Linyanti River wetlands**

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| **Provisioning Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Grazing for livestock | Local people directly – mostly subsistence herding. | The monetary value of livestock keeping by households is allocated to east Zambezi woodlands. The Kwando floodplain is relatively small compared to the Zambezi River, and its greatest extent in the south is taken up by Nkasa Rupara NP. Thus the area available for grazing by livestock in relatively small. However, for those people living close to the Kwando-Linyanti, this is obviously an important service.  | Grazing is generally good within this ecosystem, but condition fluctuates seasonally. | Livestock numbers thought to be at carrying capacity in this ecosystem, with little potential for expansion. | The holistic range management approach would help to improve productivity. Guidelines available in Namibia’s Rangeland Management Policy and Strategy, and from farmers unions and IRDNC.A shift from subsistence to production mindset would help to make livestock offtake are more regular. This is the objective of PCLD. Improved connections between the floodplain areas and hinterland would provide better seasonal grazing options (e.g. inland “seasonal” boreholes to facilitate movement). | Transboundary movement and spread of livestock diseases, notably Foot and Mouth.Climate change will possibly reduce the total river runoff, thus reduce the extent of the floodplains, which is the main grazing resource. | Floods. They rejuvenate the floodplain soils, and force the movement of livestock to other areas while the floodplains are inundated, giving them a rest from grazing pressures.Human – wildlife conflict. In some areas, people are moving out of the floodplains, with assistance from KAZA.  | Commodity-based trade (CBT) in cattle products needs to be promoted. It offers solutions to the problems that Foot-and-Mouth brings. Agriculture policy needs stronger implementation, especially in rangeland management. Incentives need to be created to bring about a shift from subsistence to a production mindset.Conservancies and Community Forests would have greater control over rangelands if grazing areas were incorporated into the CBNRM ‘basket’. |
| Crops | Local people – mostly home gardens for own consumption. There are a few commercial producers of vegetables for local markets.  | No monetary information available on crop production from this specific area. The value is combined with the value for the eastern wetlands.There is relatively little crop production in this area, but the ecosystem service (good soils, seasonal water) is obviously still important for those rural residents who farm there.  | Generally healthy | Reduction in floodplain farming, because of floods and HWC. This is being encouraged by KAZA, who provide assistance to relocate people to areas with less potential for HWC.  | No opportunities obvious. Improved non-lethal strategies for reducing HWC are needed. | Irrigation projects on Kwando (land clearing), including developments upstream in Angola.Slash-and-burn system depletes soil fertility.Climate change will possibly reduce the total river runoff, thereby reducing irrigation and crop-growing potential.  | Floods.HWC. In some areas, people are moving out of the floodplains, with assistance from KAZA. | Slash-and-burn farming needs to be replaced by conservation agriculture methods, so that wastage of land is reduced.  |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Game | Local people harvest for food.Trophy hunting (MET and conservancies).Poaching by outsiders. | All conservancies along the rivers benefit from meat from own use as well as trophy-hunted wildlife.  NNI from trophy hunting estimated at $N10.57 million p.a.Poaching – no information available. | Reasonably healthy – wildlife numbers improving (most species). | Sustainable increase of quotas.There has been a recent spike in elephant poaching. | Growth of KAZA approach – collaborative management of transboundary conservation area.Lodges could help with wildlife monitoring.CBNRM should be transboundary.Lechwe population could be boosted. This species breeds quickly and can tolerate high offtake.Community goodwill needs to be improved (e.g. through providing waterpoints away from river). The positive attitude towards moving away from the floodplains needs to be sustained.Corridors needed to link floodplains and woodlands, improving wildlife mobility. | Inadequate benefits to households from wildlife and tourism – CBNRM unpopular amongst some community and GRN decision-makers.Poaching (local and transboundary).Increase in HWC.The ban on hunting in Botswana has resulted in increased poaching, and Botswana communities are turning increasingly to the illegal bushmeat trade. Namibia should not follow this strategy as it would bring considerable threat to wildlife populations. Climate change will possibly reduce the total river runoff, thus also reducing the extent of floodplains as wildlife habitat. | Human population growth.Food security - upstream agriculture development (Namibia and Angola).Positive: Tourism is key driver for improving game numbers. | Need policy shift that encourages lodges in communal areas. The investment environment is not conducive to this: MLR requires land tax paid to land board, and MET requires fees to be paid to conservancies. This double tax needs to be rationalised.Insecure tenure on communal land remains an obstacle to private sector investors. Needs to be sorted out.Fines for poaching need to be drastically raised. |
| Game (specifically birds) | Local people harvest francolins, storks, ducks etc.Chinese workers (carmine bee-eaters - illegal export).Quotas to conservancies. | Utilisation of birds as quotas to conservancy is included in the estimate for ‘Game’ above.The value to households from food is relatively small, but not insignificant.  | Generally healthy in this ecosystem | No significant trend – some noticeable spikes from poaching of carmine bee-eaters, possibly this is more common than thought.  | Maintain / intensify wetland bird counts. Coordinate with Botswana to make them transboundary counts.Lodges to be involved in counts & monitoring.Register Kwando as a transboundary Ramsar site. | As aboveIncreasing Chinese presence a growing concern.Pollution (from agriculture, DDT, etc.) | Commercial - outsiders exploiting birds to sell.Food security - upstream agriculture development (Namibia and Angola). This directly affects the status of the floodplains.Population growth. | A Kwando profile needs to be compiled to improve awareness amongst decision-makers. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Veld foods (e.g. water lilies) | Local people harvest for food. | No monetary information available for Zambezi Region. Most households use veld foods to some extent. Relatively poorer households have greater dependence on this service.  | Generally healthy in this ecosystem. | Not noticeable. | Improvement of the Protected Area status (Namibia MET, Conservancies & Botswana MEWT) of the wetland would benefit this service.  | Irrigation projects on Kwando. Concerns are water abstraction and eutrophication, which would possibly: - reduce water volume in the river, - reduce the extent of seasonal flooding, and – reduce growth of some of the useful plants, due to degraded water quality.Climate change will possibly reduce the total river runoff.  | Food security - upstream agriculture development (Namibia and Angola).Population growth. | Add plants to CBNRM ‘basket’– conservancies should be enabled as key partner.Kwando profile needs to be compiled to improve awareness amongst decision-makers. |
| Medicinal resources | Local people use natural resources in their primary state. Many plant and animal remedies used, but poorly studied. | No monetary information available. It is not possible to quantify the value of this service, it is probably relatively small but obviously significant for local households, especially poorer ones.  | Assume stable, but no data available. | Unknown | Unknown | Irrigation projects along Kwando River. Land clearing and pollution may result in species loss.Over-exploitation of natural resources generally.Climate change will possibly reduce the total river runoff, which could reduce production of certain plants. | Unknown, but concerns that international pressure may result in species being illegally harvested as ‘muti’.As noted previously, increased Chinese presence a concern, as they are known to harvest certain species for medicinal purposes.  | As above |
| Fish | Local people harvest for food.Outsiders (for commercial purposes).Lodges – fishing is a tourism activity. Mostly catch and release. | Local fishing NNI estimated $N1.67 million p.a.Outsiders – not significant in the Kwando, where the fishery is naturally much less productive than in the Zambezi R. In order to avoid double counting, the value of angling recreation is included in tourism estimate below. | Healthy in Mamili and Bwabwata (inside parks).Under pressure in remaining areas. | Probably increasing – for food security and sale. | Maintain /improve PA status (Namibia MET, Conservancies & Botswana MEWT). This resource is key for biodiversity and food security. Management should be easy if coalition is established. This is already proposed in KAZA fish project. Fish farms, if done properly, are an opportunity. Small-scale fish ranching, using natural ponds, have potential for increasing fish production. | Irrigation projects on Kwando. If they go ahead, floodplain areas likely to reduce and provide less habitat for breeding.Crocodile farm at Kongola may negatively impact fish.Fish diseases due to fish farming.Alien invasive species generally. Climate change will possibly reduce the total river runoff, which could reduce fish productivity. | Commercial - outsiders exploiting fish to sell. People coming from elsewhere in Namibia and Botswana to harvest fish. Food security - upstream agriculture development (Namibia and Angola).Population growth.SADC Logistics Hub project may negatively impact wetlands, if a new bridge is constructed. Rural water supply projects abstract from Kwando R. | Kwando R transboundary protocol needed to improve management of this river system.Add fish to CBNRM – conservancies should be enabled as key partner.Kwando profile needs to be compiled to improve awareness amongst decision-makers. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Construction materials – poles, reeds, thatch, mud from termite mounds | Local people use traditional, locally available building materials.Wider users (thatch and reeds) for sale. | The monetary value of utilization of these resources by households is allocated to Mudumu and east Zambezi woodlands.Thatching grass, reeds and timber are all commonly used by rural households.  | Resources generally healthy in this area. | Stable | None obvious. | Fire at wrong times of the year will destroy thatching grass and reeds for that season. They regenerate but annual harvests sometimes destroyed.Climate change will possibly reduce the total river runoff, which could reduce the amounts of available materials.  | Population growth, which will increase the exploitation of the resources.  | Conservancies would have greater control over these resources if they became community forests as well. |
| Crafts | Local people.Crafts sold to tourists – Namibian and international. | NNI from craft production estimated at $N0.15 million p.a. Basketry and woven products sold at the Kongola crafts market are recognised for their fine quality and craftsmanship. This brings income and pride to women involved in these practices. | Healthy  | Stable | Marketing of crafts is done locally (Kongola) and some of the products reach Windhoek outlets. Possibly there is room for more of this, even extending to international markets. | None identified. | Tourism is the main determinant of commercial sales. Marketing plays an important role for local small industries.Transfer of skills is important for the families involved in this trade. | None suggested. Traditional values are upheld in the conservancies, and this should be maintained.  |
| Water | Local people use river water and boreholes, and reticulation of piped water is expanding from Katima Mulilo and Kongola. | Monetary value not calculated.  | Healthy | Stable | Water provision is a powerful determinant of where people settle. Provision of piped water to areas away from the river, to facilitate settlements away from the sensitive river environment, could help to reduce pressure on river resources. | Upstream (Angola) developments may cause significant reductions in river flow.Climate change might also cause mean annual runoff to decline, reducing water availability. | Population growth, both in Namibia and Angola. | Kwando R transboundary protocol needed to improve management of this river system.Kwando profile needs to be compiled to improve awareness amongst decision-makers. |
| **Regulatory and Supporting Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Air quality | Local people | No monetary information available. This is a service that is largely taken for granted, but it is important for all people, and plants and animals.  | Healthy. Veld fires cause some pollution but their impact is temporary and not severe, although they obviously do add unnecessarily to CO2 in the atmosphere. | Stable | None identified | Climate change, with increasing severity of dry spells, could cause fires to be more destructive. | Population growth, which will cause fires to become more frequent. Climate change will possibly cause fires to be more intense in future. | None suggested. |
| Erosion control Water quality and flood regulation  | Riparian communitiesLodges in Namibia and Botswana | No monetary information available for Zambezi Region.Estimates for groundwater recharge and water purification for the Okavango Delta Ramsar site: BWP3.27/ha [approx. NAD2.82/ha].[[6]](#footnote-6) | Healthy – flooding incidents/ impacts are minimal. This is mainly because the Kwando-Linyanti is a much smaller system, in terms of total runoff and flooding potential, than the Zambezi River.  | Stable. | A basin management approach, backed up by a transboundary River Commission, could help to improve water quality and quantity and flood regulation aspects. | A new or upgraded bridge (road and rail) could alter river functioning.Fast-moving power boats cause wake, that erodes riverbanks.River edge land clearing causes bank erosion. | Population growth. | Regulations needed for boats.Kwando R transboundary protocol needed to improve management of this river system.Kwando profile needs to be compiled to improve awareness amongst decision-makers. |
| Nutrient cycling e.g. CO2 , O2 , N, P. | Local people.All resident plants and animals. | Not possible to quantify, but important for maintaining fertility of the soils and for sustaining all floodplain life. | Healthy. | Stable. | None identified.  | Upstream developments that reduce the runoff will cause nutrient cycling rates to be lower.  | Population growth.Climate change. | Kwando R transboundary protocol needed to improve management of this river system. |
| **Cultural, Livelihood and Wellness Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Cultural and spiritual traditions | Local people – traditional knowledge about the wildlife and river. | Non-consumptive tourism NNI estimated at NAD60.62 million p.a.Option and non-use values are unknown. | Healthy | Stable | Cultural tourism.Strong cultural links to the resource base will improve management. Programmes to reconnect young people to cultural resources should emphasise the value of traditional knowledge and cultures.Tourism sector can facilitate synergies around traditional knowledge and resource management. | Negative aspects of tourists and development, which can erode traditional values.  | Population growth, urbanisation, tourist numbers and activities.  | None suggested. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Tourism and recreation | Local peopleTouristsHunting sectorBeneficiaries are transboundary | Non-consumptive tourism NNI estimated at NAD60.62 million p.a. | Healthy. | Stable to slight increase. | Tourism is under-invested and under-developed – there is scope for improvement, but not expansion. Lodges could collaborate in the management of some tasks (e.g. waste, laundry services). Incentives for ‘greening’ lodges, such as Eco-Awards, should be implemented. There are many opportunities for diversifying the tourism sector e.g. fishing lodges in conjunction with fish protection areas, cage dives for crocodile viewing, tree houses, bush walks, … | Poorly managed mass tourism (e.g. noisy boats, aircraft) could threaten the market. Inappropriate development (e.g. Green Schemes reducing the river water levels) could carry large opportunity costs, hitting the tourism sector. The international lobby against hunting (which has already affected Botswana) could severely impact tourism revenues. Poor security, inadequate law enforcement (wrt fish, wildlife), poaching and other illegal activities can jeopardise tourism markets. Many factors can affect the tourism sector: Land Board tax, urban growth, fences, HWC, poorly planned infrastructure.  | Communal land policy and land tenure. Urban growth (especially Kongola). | Need policy shift that encourages lodges in communal areas. The investment environment is not conducive to this: MLR requires land tax paid to land board, and MET requires fees to be paid to conservancies. This double tax needs to be rationalised.Insecure tenure on communal land remains an obstacle to private sector investors.  |

**Table 5: Ecosystem services derived from eastern Zambezi wetlands**

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| **Zambezi and Chobe Rivers and floodplains (includes the conservancies Lusese, Sikunga, Kabulabula, Impalila, Kasika & Nakabolelwa)** |
| **Provisioning Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Grazing for livestock | Local people are direct beneficiaries.Sub-region generally (open systems) – key component of larger area.Strong linkage to hinterland, as cattle move off floodplains during wet season, to woodland areas for seasonal grazing. | NNI from livestock grazing estimated at $N10.65 million p.a.For those people who do own cattle, there is a very strong attachment to the livestock for status and livelihoods. | Healthy | Roughly at full carrying capacity. The floodplains are seasonally overstocked but this is natural for the system, and even beneficial through the fertilising effect of manure. | Commodity-Based Trade to relieve the restrictions imposed by Foot-and-Mouth Disease. More commercial production.Genetic superiority of Sanga cattle, suiting them well for local conditions.  | Transboundary diseases, especially FMD from buffalo.Cattle movements into neighbouring countries, increasing exposure to diseases.Human-wildlife conflict, from predators killing livestock.Climate change will possibly reduce the total river runoff, thus reducing the extent of the floodplains. | Disease status of the Region and how international markets respond to this risk.  | Need commodity-based trade (CBT) of beef. Agriculture policy – need greater implementation of the national Rangeland Management Policy and Strategy.Conservancies would have greater control over grazing resources if they became community forests as well. |
| Crops  | Local people – maize, sorghum, millet, vegetables.Green Schemes – rice. | Crop production NNI estimated at $N51.99 million p.a. | Healthy | Stable, but fluctuates depending on floods and sporadic HWC.  | Greater production (especially vegetables\_ for local (Katima Mulilo) market and growing tourism demand. Value-adding to maintain the demand even when there is occasional over-supply (e.g. a short glut of tomatoes). | Expectations that the perennial rivers can support intensive irrigated production.Inadequate EIAs & oversight of the EIAs allow potentially significant negative impacts to be given Environmental Clearance. | Population growth.Human wildlife conflict can significantly lower production, especially for small-scale growers. | EIAs need improved quality control, and they should include cost-benefit analysis to assess viability. |
| Game  | Local people.Trophy hunting.Local people and foreigners involved in poaching. | No information on the monetary value derived by local people.  NNI for trophy hunting estimated at $N8.45 million p.a.Poaching – no information available. | Reasonably healthy – wildlife numbers improving.  | Sustainable increase in quotas given by MET. | KAZA, promoting transboundary collaborative management. Lodges, which could be more involved in monitoring wildlife.Boosting lechwe population – this species has potential for high offtake. Goodwill of local communities towards wildlife and CBNRM. Corridors, linking floodplains and woodlands. | The ban on hunting, in place in Botswana, could threaten economic rewards from wildlife if it is introduced in Namibia. Poaching on the Zambezi floodplains is a bigger problem than on the Kwando.Inadequate benefits to households from wildlife and tourism, leads to local communities resorting to illegal trapping and hunting. Increase in HWC. | Population growth. Tourism is a strong positive driver for increase in benefits from wildlife. | Need policy shift that encourages lodges in communal areas – more conducive investment environment (MLR – land tax to land board, tenure problem, MET – fee to the conservancy).Policy does not promote high quality tourism investors. Need commodity-based trade of beef, so that wildlife does not pose a threat to livestock marketing.  |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Game - specifically birds  | Local people.Foreign (Far-East) workers, for food + feathers).Conservancies (quotas) – ducks + gamebirds. | No monetary information available for values for local people and foreign workers. Utilisation of birds as quotas to conservancy is included in the estimate for ‘Game’ above, to avoid double counting. | Generally healthy, but exploitation of carmine bee-eaters for feathers is a problem. | Stable but concern over carmine bee-eaters. | None | Illegal trapping. | As above. | Need improved law enforcement – lodges could assist as ‘Honorary Wardens’ or with monitoring.  |
| Fish | Outsiders fishing commercially – Zambians, DRC residents.Local people, with main market in Katima Mulilo.Lodges (minor).Hinterland of SADC – Zambia, Zimbabwe, DRC…. | Local fishing NNI estimated at $N3.17 million p.a. Values for recreational fishing are included in ‘Tourism and recreation’ to avoid double counting.  | Zambezi River and Chobe River – poor. Lake Liambezi – FairSikunga Fish Protected Area - very good | Commercial offtake – unsustainable. Nets used are destructive.Some small fish ranching doing well.Most productive area – the floodplains – lie mostly in Namibia, less in Zambia.  | Align Zambia-Namibia closed season & regulations about fishing gear. Coordinate Zam-Nam law-enforcement. Management must be collaborative. CBNRM – fish to be added to the harvestable resources. KAZA project objectives – promoting transboundary and multi-agency cooperation.Fish farms would be beneficial, as long as they are managed properly. | Foreigners using destructive nets, fishing and exporting in large groups. Fisheries being seriously over-exploited in certain areas.Future irrigation projects on the Zambezi River.Green Schemes within Namibia – potentially high abstractions.Crocodile farms?Diseases from alien fish and competition from alien invasive species.Climate change will possibly reduce the total river runoff, which is likely to affect fish populations negatively.  | Ineffective law enforcement.Demand from neighbouring countries, led by population growth and depletion of their resources.Upstream developmentsUpgraded roads, making access easier and bridges possibly having impacts on downstream flows.  | Policy must recognise that offtake for subsistence and the local economy is sustainable, but commercial offtake for export is not.MFMR and MET regulations wrt CBNRM.Local (municipal) by-laws should be specific about not allowing commercial offtake and export. Enforcement could be supplemented by Local Authorities. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Veld foods, especially water lilies.  | Local people. | Wild food harvest has been estimated in miombo woodlands as 6% of total household environmental income[[7]](#footnote-7), varying between 2.6-6.8% depending on income quintile.[[8]](#footnote-8)  | Healthy | Stable | Improvement of the Protected Area status (Namibia MET, Conservancies & Botswana MEWT) of the wetland would benefit this service.  | Irrigation projects on the Zambezi. Concerns are water abstraction at low-flow times of the year, which would possibly: - reduce water volume in the river, and – reduce growth of some of the useful plants, due to degraded water quality.Climate change will possibly reduce the total river runoff.  | Food security - upstream agriculture development (Namibia and Angola).Population growth. | Add plants to CBNRM ‘basket’– conservancies should be enabled as key partner. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Fuel and energy | Local people | NNI from fuelwood collection and use estimated at $N42.54 million p.a. All rural households use firewood as a fuel, as well as most urban households. | Healthy, but local over-exploitation of firewood around towns. | Increasing. Wood resources being over-exploited near towns.  | None identified. | High level of fuelwood harvesting near towns and settlements. | Population growth | Greater enforcement of the Forestry Act.  |
| Construction materials – reeds, thatch, mud/termite mounds | Local people.Wider users in Namibia (thatch and reeds) | NNI of building poles, thatching grass and sawn timber estimated at $N5.63 million p.a. | Healthy | Stable  | Use of poles and thatch for housing is aesthetically pleasing, has good thermal properties, and the resources are renewable (in comparison to corrugated iron for example). Lodges recognise this value of ‘traditional African style’. The practice could be increased as long as harvesting rates are controlled. | Fire. | Population growth, which is likely to increase the frequency of fires. | Conservancies would have greater control over these resources if they became community forests as well.Harvesting of reeds and thatch needs to be more rigorously controlled.  |
| **Regulatory and Supporting Services** |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Water quality and flood regulation | Riparian communities.Lodges and urban centres.Downstream countries.Agricultural industries. | No monetary information available for Zambezi Region.Estimates for groundwater recharge and water purification for the Okavango Delta Ramsar site: P3.27/ha [approx.N$2.82/ha].[[9]](#footnote-9) | Healthy – flooding incidents occur, but these are natural and they only cause problems because people settle in flood-prone areas. | Stable | Need improved basin management approach to facilitate early-warning systems | River edge land clearing.  | Population growth.Poorly planned infrastructure developments.  | The basin management approach that has been started, needs to be sustained and grown. This will improve management of the shared river resources between basin states. |
| Soil formationThe peat layers left after years of Lake Liambezi holding water, provide excellent soil (‘sitapa’) for cultivation.  | Local people.Agricultural industries. | No monetary information available. Peat formation is an important part of the ecosystem dynamics of Chobe and Lake Liambezi.  | Healthy.  | Stable | None identified. | Attempts to fill Lake Liambezi artificially will cause the very fertile peat layers to be unused for cultivation and grazing, thus ‘wasting’ this beneficial process.  | Natural long-term fluctuations in water level, that cause Lake Liambezi to dry out intermittently.  | The basin management approach that has been started, needs to be sustained and grown. This will improve management of the shared river resources between basin states. |
| Nutrient cycling  | Local people. Specifically significant in Lake Liambezi, for fishing sector and farming in the peat when the lake is dry.  | Very important for sustaining the fertility of ‘sitapa’ soils. Crop production in these areas makes a significant contribution to rural livelihoods.  | Healthy | Stable | None identified. | Attempts to fill Lake Liambezi artificially will prevent intermittent drying out of the lake, so that the soils will not be fertilised by cattle dung. Long term fish productivity will probably decline. | The Zambezi river system has distinct pulses – physical and biological. These fluctuations are normal and natural and should not be interfered with. | Basin management approach. |
| **Cultural, Livelihood and Wellness Services** |
| Cultural and spiritual | Local people – attachment to wildlife and rivers.Traditional knowledge and materials.Rituals – e.g. significance of hippos in local traditions. | Difficult to value, but cultural practices obviously carry strong significance for local people, and play a part in traditional knowledge.  | Healthy | Stable – access issues | Cultural tourism. Strong cultural links to the resource base will improve management – programmes to reconnect young people to cultural resources.Emphasise value of traditional knowledge and cultures, which are based on ‘wise use’ of resources. An important facet of sustainable use.  | Negative aspects of tourists and development, which can erode traditional values.  | Population growth, urbanisation, tourist numbers and activities.  | None suggested. |
| **Type of Ecosystem Service (ES)** | **Beneficiaries/ users** | **Value** | **Current state of ES** | **Trends of ES use and value** | **Opportunities & synergies (incl. trans-boundary)** | **Threats & antagonisms****(incl. trans-boundary)** | **Key drivers of change in ES and usage** | **Policy adjustments to be considered** |
| Tourism and recreation | Local people.Tourism (establishments and service sector).Hunting sector. | NNI from non-consumptive tourism estimated at $N69.87 million p.a. | Healthy, but some local degradation e.g. pollution and overcrowding along Chobe waterfront. Ecosystem service undermined by inappropriate resource exploitation (e.g. fishing gear), littering, erosion, etc | Stable – slight increase – overexploited in Chobe.  | Tourism underperforming, under-invested, underdeveloped – some scope for improvement but not expansion. Lodges could collaborate re management (waste etc). Eco-Awards create incentives for improved practices at lodges. More cultural tourism? Possibility for additional conservancies in east, improved benefit sharing, MET and MLR should collaborate to streamline rules. Katima Mulilo could become a tourism hub.  | Inappropriate development (e.g. Green Schemes, urban growth, sewage, ), inappropriate and low-value tourism (House Boats, noisy boats, aircraft). Some lodges unwilling to go into Joint Ventures with local communities. Poaching and other illegal activities. Inadequate law enforcement (fish, game).Excessive levies and taxes on tourism operators. HWC gives local people anti-tourism attitudes. | Economic/land policy, Katima Mulilo growth. Land tenure policy. Flooding | Land board taxes need reconsideration.  |

# Results and discussion

##  Modelled values

Derivation of the economic values presented in this section, is described in Appendix C.

Tables 6 and 7 show the results of the modelled analysis; the estimated current values of direct contributions to the economy in each of the four sub-regions (as can also be seen in the Tables 2 - 5), and as a total for the whole of Zambezi Region.

**Table 6: Estimates for current annual economic direct use values for modelled ecosystem services in the four sub-regions of the study (N$ millions, 2013)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Current annual values** | **Kwando core area and central Bwabwata** | **Kwando River and floodplains** | **Mudumu and east Zambezi woodlands** | **Zambezi River and floodplains** |
| **Provisioning services** |  |  |  |  |
| Livestock grazing | 0.18 | - | 16.44 | 10.65 |
| Soils/crops | 1.09 | - | 99.19 | 51.99 |
| Game | 4.23 | 10.57 | 4.23 | 8.45 |
| Fish | - | 1.67 | - | 3.17 |
| Fuel/energy | 0.89 | - | 81.15 | 42.54 |
| Thatching grass, building poles and timber | - | - | 10.83 | 5.63 |
| Craft production | - | 0.15 | 0.13 | - |
| **Cultural services** |  |  |  |  |
| Tourism and recreation | - | 60.62 | 95.56 | 69.87 |
| **TOTAL** | 6.39 | 73.01 | 307.53 | 192.3 |

**Table 7: Modelled estimates for current annual economic direct use values in the two main ecosystems in Zambezi Region (N$ millions, 2013)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Current annual values** | **Woodland** | **Wetland** | **Zambezi Region** |
| **Provisioning services** |  |  |  |
| Livestock grazing | 16.62 | 10.65 | 27.27 |
| Soils/crops | 100.28 | 51.99 | 152.27 |
| Game | 8.46 | 19.02 | 27.48 |
| Fish | 0 | 4.84 | 4.84 |
| Fuel/energy | 82.04 | 42.54 | 124.58 |
| Thatching grass, building poles and timber | 10.83 | 5.63 | 16.46 |
| Craft production | 0.15 | 0.13 | 0.28 |
| **Cultural services** |  |  |  |
| Tourism and recreation | 95.56 | 130.49 | 226.05 |
| **TOTAL** | 313.94 | 265.29 | 579.23 |

##  Discussion

The main points arising from the tables and values are briefly discussed below.

**Most important ecosystem goods and services**

An important economic activity in the Zambezi Region is wildlife-centred tourism, an activity based around the provision of accommodation at lodges and campsites, and the strong presence of iconic African wildlife such as elephants. This accounts for the very high values associated with tourism in both the wetland (N$ 130.49 million) and woodland (N$ 95.56 million) ecosystems. Investments have been made by private sector operators, as well as in joint ventures between operators and rural communities, while some conservancies have also invested in their own campsites. Additionally, high values derive from trophy hunting operations, which are joint ventures when they take place within the conservancies.

Virtually all households practice crop production – mainly for maize, millet and sorghum – and these represent the second highest value in wetland ecosystems (N$ 51.99 million). In woodlands they are roughly the same (N$ 100.28 million) as the value from tourism.

Nearly all households make use of wood resources for fuelwood, which is the third highest service provided by woodlands (N$ 82.04 million) and wetlands (N$ 42.54 million). All other services are valued considerably lower than tourism, crops and woodfuel.

**Ecosystem service trends**

The provisioning ecosystem services are largely centred on food security, with products harvested directly for local consumption. This is changing as commercial offtake increases, as is seen in the fisheries sector and devil’s claw. In many cases, a deteriorating trend is a result of such commercial over-exploitation.

Such over-exploitation raises the need for improved management of the resources. This is clearly recognised in the fisheries sector, but poor implementation of regulations on the ground hampers the control of illegal practices. Proclamation of Fish Protection Areas, as suggested in the IRLUP, is one mechanism to help recovery of fish populations.

**Opportunities**

The large number of conservancies in Zambezi Region creates a mechanism for sustainable exploitation of the commonly used resources. The ‘basket’ for CBNRM products is gradually being expanded, with Fish Protection Areas now being established through the conservancies. As mentioned under Policy Adjustments, the basket needs to be expanded still further.

Transboundary cooperation is already practiced (such as shared wildlife monitoring in Namibia and Botswana), and this collaboration should be strengthened. KAZA is an obvious forum to expand the existing arrangements between conservancies and wildlife departments in the neighbouring countries. Local communities and even the Zambezi Governor, during the IRLUP process, called for recovery of lechwe populations on the floodplains. This is a species that can tolerate high offtake levels, and is one example of an opportunity for greater benefits flowing from wildlife that could be taken up by Namibia and the other KAZA members.

The growing acceptance for Commodity-Based Trade, which requires dedicated treatment to allow marketing and export of livestock products from FMD-endemic areas, is a significant opportunity to improve the livestock sector in the Region.

**Threats**

The Kwando River is a small, clean, low energy, low nutrient river. These are important characteristics of the Kwando wetland ecosystem, and the services from the river could be jeopardized if they are changed. For instance, abstraction of water for any large-scale irrigation project could significantly reduce the flow volume. Also, the low level of nutrients could be disturbed by runoff of fertilisers from irrigation schemes, which would retard the growth of phragmites reeds (which prefer low nutrient conditions). Both of these factors would negatively affect fish breeding areas.

Irrigation projects in Namibia itself (as suggested along the Kwando River in the Zambezi IRLUP) and upstream in Angola could possibly threaten many wetland ecosystem goods and services. The likelihood of developments such as dams or power generation schemes on the Kwando is low, considering the small total discharge of this river, the flat terrain, and the remoteness of this part of south-eastern Angola. However growth in irrigation is more likely. In Namibia, the SEA of the Zambezi IRLUP noted the likely poor viability of irrigation projects along the Kwando, due to the small runoff of the river. But local stakeholders in the planning process were adamant that Green Schemes had been offered by government and planning for feasibility needed to commence. The SEA made the further point that all projects of this nature would be obliged to undergo an environmental assessment, resulting in an Environmental Clearance Certificate, before being allowed to commence.

Increasing populations of wildlife in Zambezi Region, and the rising status of conservancies, stands to be broken down by a backlash against problems such as human-wildlife conflict and a low level of benefits flowing to conservancy members. A growing problem is poaching. Human-wildlife conflict and poaching are significant threats that need to be dealt with effectively if the considerable benefits from tourism are going to be sustained.

The value of much of the Zambezi Region tourism experience lies in its wildlife + wilderness atmosphere. This could easily be changed by unplanned growth in towns such as Kongola and Ngoma. Improved road access is also likely to negatively impact wildlife populations through increased poaching. The growth in towns and roads needs to be well planned and complemented by increased management effort, such as more MET staff in the region.

**Policy adjustments**

A number of suggestions are made in the tables for improving the policy framework that influences the value of ecosystem services. Important issues are:

* Inadequate access for Bwabwata N.P. residents to the plant and animal resources in the Park. This links to Namibia’s commitments under the Nagoya Protocol on Access and Benefit- Sharing.
* The need for Commodity-Based Trade for beef, so that obstacles against marketing livestock products can be overcome;
* The need to expand the products in the CBNRM basket, and bring greater collaboration in management by Community Forests and Conservancies;
* A more conducive investment environment for tourism;
* The need for transboundary collaboration in management of fisheries, wildlife populations, and many other resources. Specifically, a transboundary basin management forum needs to be established for the Kwando River. Although the Kwando is strictly part of the Zambezi River Basin, and therefore falls under the umbrella of the Zambezi River Commission (ZamCom), there are local issues that need to be addressed between Angola, Zambia, Botswana and Namibia that do not need the involvement of the four other ZamCom countries. A smaller, more effective forum for resolving transboundary issues should be established.

##  Conclusion

This Ecosystem Services assessment brings attention to the main ecological processes and resources that need to be sustained in the future land use of Zambezi Region. Its main points, that need to be reflected in the IRLUP, are:

 \* The very high value of tourism, which is based on the wetlands and wildlife found in the area. Both depend on appropriate trans-boundary management, such as the activities in the KAZA trans-frontier conservation area.

 \* The high value of crops. This emphasises the need for reducing human-wildlife conflict, especially by elephants. Conservancies play an important role in this regard, as they have management mechanisms for addressing the problems that come from living with wildlife.

 \* While cropping is important, irrigation development needs careful planning so that it does not negatively impact other sectors such as tourism and fisheries. In particular, there are limits to what can be achieved by irrigation on the Kwando-Linyanti river system. This is due to the small size of the water source and the importance of the other ecosystem services, such as the floodplains supporting wildlife and fisheries.

 \* Fisheries play a vital role for the local people, even though the calculated monetary value is relatively low. This emphasises the need for land uses and projects that do not negatively impact fish populations.

Zambezi Region can be proud that most of the ecosystem services are described as being healthy, and the trend in their use as stable. (The one exception to this is the fisheries.) There are considerable monetary and livelihood benefits from this situation, so efforts to retain this status should be supported. For instance, the veterinary and agricultural practices (such as FMD vaccinations and protection of crops and livestock against wildlife damage) should be sustained. It is hoped that this Ecosystem Services Assessment, and the Strategic Environmental Assessment, can influence land use practices to continue this trend.

# Lessons learned

A full description of how the 9-step process was followed, is provided in Appendix D. Practical points arising from this evaluation are set out below.

**6.1 Field assessment**

* Do the ES assessment as early as possible in an SEA, so that its results can be used in all subsequent planning discussions (see Figure 1). Ensure that the assessment includes ample field work, allowing enough time to ‘absorb’ the various aspects of the ecosystems.
* Coordinate the scheduling of the ES work with the client (MLR) and the other consultants (planners, mappers). The assessment can achieve its greatest influence if the other components of the IRLUP process, particularly the Participatory Land Use Planning meetings, follow after the ES field work.
* Plan what sort of data will be gathered. Consider ways to express the value of ecosystem services in ways that people can understand, and in ways that will be quantifiable. Therefore it should not be restricted only to monetary values. Other quantitative and qualitative data can show value to people, such as number of households relying on a particular resource, contributions to food security, price of the goods on the market, how the service reduces risks, frequency of use of materials such as fire wood or construction materials.
* With respect to data, aspects that need to be considered include:
	+ Gathering adequate samples to be representative;
	+ How the data can show trends, to demonstrate sustainable use of the resources/services, or over-use that could lead to exhaustion;
	+ The need for the SEA to show information on alternative options for development.
* Use maps to visualize ecosystem service users and providers. For instance, the 1:250,000 topo-cadastral maps show the important geographical features, which are also important in an ecological sense. Where possible, add features which are relevant to ecosystem services. E.g. location of livestock marketing points (auction kraals, bush markets, abattoir); areas of bush encroachment; selling of woodland products (e.g. thatch, poles, charcoal, wooden crafts); fish markets. Record GPS coordinates for all these places during the field work, and include them where relevant in the mapped information.
* Take as many photos as you can when doing the ES fieldwork. Pictures make a great addition to the presentations that will be necessary to explain environmental features and their link to livelihoods.
* Arrange appointments with as many local representatives of the regional economy, as possible, to dig out ES information. This might include local farmers groups, conservation experts, tourism operators, agriculture extension officers, health inspectors, civil society organisations, etc. Learn about what resources they need, what obstacles they face, how they deal with problems.

**6.2 Compilation of ES information to influence the IRLUP process**

* Present the opportunities and synergies that arise from ecosystem services, so that they can influence the land use planning process. Suggestions for economic activities and particular land uses should be introduced, motivated by the livelihood and/or economic values that they could create.
* Present alternative development scenarios that take into account the role ecosystem services play.

**6.3 Communication**

* If economic valuation is applied, then the methodology and statistical models used should be communicated in a way that non-experts can understand. The value of ecosystem services must be stated in a variety of ways, such as livelihoods, benefits to local people, and other ways that decision makes can relate to.
* Try to maximise political buy-in by sharing the ES information. For instance, make an appointment with the regional authorities (e.g. Regional Council, Regional Development Coordinating Committee, Traditional Authorities) to present the findings of the ES assessment. Emphasise the value of ecosystem services as a safety net for relatively poor households, so that the relevance of the work as being ‘pro-poor’ is understood.
* Make the ES information appropriate for the target audiences. Keep presentations simple and clear, with plenty of photographs linking features of the ecosystems with livelihoods, employment and the economy. Show people involved in day-to-day activities. Show examples of various local plants and animals, and discuss what their requirements are, and how they contribute to ecological processes. Describe the benefits that arise from them, and the monetary values that are derived from them. Show features that have a negative impact, such as pollution, bush encroachment, wastage of water. Use headlines from newspaper articles to show how issues are relevant to local interests. The presentation should have just a few (maximum 5) main messages, with a clear conclusion about the issues and what should be done.
* Local stakeholders and authorities do not need to recognise the different categories of services, namely provisioning, cultural, regulatory. So it is not worth spending time describing the categories e.g. by motivating why tourism is classified as a different service from food provision. The important principle is that people should be made aware of the goods and services that they use from the natural environment, and what they need to do to sustain them.

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# Appendix A: Participants in the specialist workshop on Zambezi Region Ecosystem Services.

|  |  |
| --- | --- |
| **Name**  | **Affiliation / role** |
| Jon Barnes | Independent consultant. Resource economist |
| Chris Brown | Sustainable Solutions Trust cc. Former wetlands and bird biologist, MET, and Director of Namibia Nature Foundation |
| Richard Diggle | WWF, with main focus on Zambezi Region conservancies. |
| Holger Kolberg | Wetland biologist, MET. |
| Dorothea Nakatana | SAIEA assistant. |
| Karine Nuulimba | IRDNC, with much involvement in Zambezi conservation issues |
| John Pallett | SAIEA, led SEA of Zambezi IRLUP |
| Ulrich Scheffler | MLR representative  |
| Joe Tagg | Independent Consultant. Former conservation officer in Zambezi Region, MET, and involved in conservancies. |
| Peter Tarr | SAIEA, workshop facilitator |
| Denis Tweddle | NNF, fisheries biologist in Zambezi Region |

# Appendix B: Zambezi Region stakeholders interviewed during Ecosystem Services fieldwork.

|  |  |  |
| --- | --- | --- |
| **Name**  | **Responsibility / Position** | **Institution / Organisation** |
| Beaven Munali | SAIEA local expert | Katima Mulilo |
| Mr Hepute | Acting Chief Agric Technician | Kalimbeza Rice Project |
| Fabian Liveve | Chairperson | Sikunga Conservancy |
| Albert …  | Fish Guard | Sikunga Conservancy |
| Lawrence … | Fish Guard | Sikunga Conservancy |
| Florence Liveve | Manager | Sikunga Fish Farm |
| Dr Frank Chitate | State Vet, Katima Mulilo | MAWF |
| Raymond Kwenani  | Enterprise Officer | Salambala Conservancy |
| Botha Sibunga | Chairperson | Salambala Conservancy |
| Boniface Saisai | Manager | Salambala Conservancy |
| Judy Mwinga | Treasurer | Salambala Conservancy |
| Kachana Metuda | Secretary | Salambala Conservancy |
| Crispin …  | Local fisherman | Lake Liambezi |
| Romeo … | Local fisherman | Lake Liambezi |
| Kenneth !Uiseb | Director, Scientific Services | MET |
| Bartholemew … | Vice-Chairperson | Bamunu Conservancy |
| Jeromy … | Manager | Bamunu Conservancy |
| Austin … | Secretary | Bamunu Conservancy |
| Jessica … | Treasurer | Bamunu Conservancy |
| Sanette … | … | Bamunu Conservancy |
| … | Enterprise officer | Bamunu Conservancy |
| Colin … | Field officer, Acting Manager | Dzoti Conservancy |
| Mr Salimbo | Induna | Dzoti Conservancy |
| Smis | Enterprise officer | Dzoti Conservancy |
| Robert Makaya | Acting Secretary | Dzoti Conservancy |
| Dozi … | ?  | Dzoti Conservancy |
| John Morris | Chairman | Wuparo Conservancy |
| Lisa … | Secretary | Wuparo Conservancy |
| Walters … | Managemt Committee mrmber | Wuparo Conservancy |
| Imelda … | Treasurer | Balyerwa Conservancy |
| Justus … | Field Officer | Balyerwa Conservancy |
| Melvin … | Area representative | Balyerwa Conservancy |
| Albert … | Chairperson | Sobbe Conservancy |
| Norika … |  | Sobbe Conservancy |
| Hirta … | Enterprise Officer | Sobbe Conservancy |
| Amos … | Ranger | Sobbe Conservancy |
| Ronnie … | Staff supervisor | Sobbe Conservancy |
| Motahane … | Senior ranger | Sobbe Conservancy |
| Bennett … | … | Sobbe Conservancy |
| Joseph Ndara | Game Guard | Kwandu Conservancy |
| Vincent … | Senior Game Guard | Kwandu Conservancy |
| Amos … |  | Kwandu Conservancy |
| Betty … | Cleaner | Kwandu Conservancy |
| Francis … | Gardener | Kwandu Conservancy |
| Zorrick Msole | Manager | Mayuni Conservancy |
| Warren … |  | Mayuni Conservancy |
| Fidel … |  | Mayuni Conservancy |
| Steve … | Enterprise Officer | Mayuni Conservancy |
| Jessica … | Treasurer | Mayuni Conservancy |
| Bester Mutanincwa | Manager | Mashi Craft Centre |
| Maeves Kulibabika |  | Mayuni Conservancy |
| Patricia | Secretary | Kyaramacan Association |
| Fidi Alpers | Community facilitator | IRDNC |
|  |  |  |

# Appendix C. Values for ecosystem goods and services

The values used in this analysis generally reflect the approach developed in the Economics Unit of the Ministry of Environment and Tourism. Economic values can be expressed in a variety of ways, and to enable meaningful comparison it is important that those used are defined and explained. The approach to valuation adopted for this project fits within the resource economics concept of **total economic value** (TEV). The total economic value of an ecosystem comprises direct use, indirect, option and non-use values.

* **Direct use values** may be generated through the consumptive use of resources (e.g. hunting and/or gathering, which provide a provisioning service) or non-consumptive use (e.g. photographic tourism or bird watching, which provide a cultural service).
* **Indirect use values** are values generated by outputs from ecosystems that form inputs into production by other sectors of the economy, or that contribute to net economic outputs elsewhere in the economy by saving on costs. These outputs are derived from ecosystem functioning such as carbon sequestration, water flow regulation and provision of wildlife refugia. These are also categorised as regulatory services.
* **Non-use values** include the value of having the option to use the resources (e.g. genetic) of ecosystems in the future, and the value of knowing that their biodiversity is protected. Although far less tangible than the above values, non-use values are reflected in society’s willingness to pay to conserve these resources, sometimes expressed in the form of donations.

With specific reference to the valuation of ecosystem services using the TEV framework, Kumar ([2010](#_ENREF_8)) states that provisioning services have direct and option values only (indirect and non-uses are not applicable), it is only possible to estimate indirect and option values for regulating services (not for direct or non-use values), while for cultural services, estimates can be made for direct, option and non-use values.

In practice, however, indirect and non-use values are rarely if ever empirically valued, as opposed to being described ([see for example Stringer et al. 2012](#_ENREF_16)). The dearth of information with respect to these values in the Zambezi Region holds across Namibia for non-provisioning ecosystem services, including studies specifically examining protected areas and communal lands outside protected areas ([Turpie et al. 1998](#_ENREF_19), [Turpie et al. 2004](#_ENREF_22), [Turpie et al. 2006](#_ENREF_18), [Barnes 2013](#_ENREF_2)).

Thus, the values presented in Tables 2-5 are all direct use values (unless otherwise indicated), and are measured as economic value, or the contribution to net national income (described in more detail below). All values are presented in Namibia dollars (N$) at 2013 prices. This annex also provides additional information about ecosystem service values as calculated by the enterprise models described below.

**Economic value** is defined as the total value added to national income, which reflects all income generated as a result of an activity, and not just the net profit for the investor or community. Put another way, it represents the returns to the internal factors of production (land, capital, labour and entrepreneurship) employed in the activity. It includes payments to government and other economic actors, such as remuneration to employees, taxes, interest and capital repayments, and rental payments. All these things together represent the annual contribution made by the activity to the national income. This measure allows the value to be assessed in terms of statistics that are generated for a country’s whole economy on a regular basis. These statistics include gross national income (GNI) and net national income (NNI), which are the returns in gross and net value added to factors of production owned by a country’s citizens (Gittinger 1982). NNI is GNI minus annual capital asset depreciation.

Value added to national income comprises **direct value added** and **indirect value added**. Direct value added is the income generated directly in the operations of the enterprise or activity - in the first round of expenditure. Operations result in expenditures on inputs from other sectors, which generate further rounds of value added. These ‘backward linkages’ create a multiplier effect, increasing the overall impact of the activity on the economy. The magnitude of the multiplier effect is calculated using an input-output model such as the social accounting matrix (SAM), developed and described for Namibia by Lange & Schade (2008). Inclusion of the income multiplier effects in the present study might increase the economic contributions measured by between some 1.6 and 2.5 times, depending on the type of enterprise (Cartwright & Lange (2005)). In the present analysis only direct value added has been used.

Figure 1 is an attempt to illustrate the relationships between the various values described above.

In measuring economic value, prices were adjusted to correct for distortions, wherever market prices did not reflect true value (e.g. if a commodity such as labour has its price fixed by government rather than established in a free market). This true value was taken to be its opportunity cost (the value of its best alternative use). Where actual prices differed significantly from opportunity cost, then ‘**shadow pricing**’ was applied. Shadow pricing ensures that values applied to inputs and outputs reflect their opportunity cost or real scarcity in society (rather than simply market prices). Standard criteria for shadow pricing developed in the past for Namibia (Barnes 1994; Humavindu 2013) were used to make these adjustments.



**Figure 1: Illustration of the relationships between (1) private and (2) economic values, as well as (3) the backward linkages to the broader economy**

 **Enterprise models**

The enterprise models utilized in this study were developed initially for community conservancies and protected areas, but have been extended in this study to incorporate communally held land outside of those categories. These models are the basis for the estimates of NNI for most provisioning services described and valued in the table, as well as for the cultural service of ‘recreation and tourism’.

The livelihood and economic values of the activities listed above have been studied and estimated for each of the four sub-regions. As this was a desk-top study, for the present project, data were drawn and adapted from Barnes 2013. These are detailed spreadsheet budget cost-benefit models, at constant 2013 prices, of the kind developed and used by the Economics Unit of the Ministry of Environment and Tourism. These models generate ‘typical’ examples of relatively homogeneous enterprises, using empirical data on the physical and financial characteristics of the enterprise type (e.g. tourism, livestock, natural resource utilisation). The values in the models are estimated to represent long-term average conditions, after consideration of the (often) wide variations that take place around these averages.

The enterprise models were developed for typical examples of the natural resource uses listed above. Models and data used were derived from Barnes (1998, 2001, 2013), Barnes et al. (2001, 2008, 2009, 2012), Chemonics International Inc, (2011), Humavindu & Barnes (2003), Massyn et al. (2009), Turpie et al. (2006), Parviainen (2012), and Suich (2010). Data for the upgrading and updating of models, and the aggregation of values for the study area were obtained from Indongo et al. (2010), Chase (2007), Suich ([2003](#_ENREF_17)), Evans (2004), Jones & Barnes (2009), Massyn et al. (2009), Martin (2006), Barnes et al. (2010), NACSO (2010, 2013a, 2013b), NTB (2013) and Mendelsohn & Roberts (1998). For the purposes of this study, the assumptions underlying the enterprise models that have been developed for conservancies are assumed also to hold for those enterprises across the Zambezi Region.

Basically, the enterprise models include details of all initial capital required for start-up in an enterprise, the annual variable and fixed operating costs at full production, and the annual sales or gross income at full production. These generate annual private net incomes after variable and fixed operating costs and fixed costs associated with capital and annual contribution to local livelihoods for households and communities. The models also generate private internal rates of return and private net present values over ten years with a real discount rate of eight percent.

In addition, the models, after shadow pricing, generated economic value in gross output, incremental annual change to gross national income and incremental annual change to net national income. Further, the economic internal rate of return and net present value at eight percent real discount rate were generated.

Of these values, the incremental annual contribution to national income in the form of *gross national income* and *net national income* is considered most important for the purposes of this assessment, and it is these values that are provided in Table 6; however, a range of values are reported in Section 4 below.

 **Other values**

A number of values are presented in the accompanying table that have not been derived from the enterprise models, but have been sourced from available literature. The methodological difficulties of valuations with respect to resource valuations is discussed in [Shackleton and Clarke (2007](#_ENREF_15)), who note that as a result, many findings are not directly comparable to one another. Further, whilst it can be informative to understand values from existing studies, the diversity of ecosystem elements and functions in any one location means that the use of benefits transfer is cautioned against by a number of valuation scholars (e.g. Turpie, 2013). Thus, where possible, values for ecosystem services have been provided as an indication of values that have been estimated, but this does not imply that these are accurate estimates of the value of ecosystem services – especially regulating and supporting services – in the Zambezi region.

The importance of the contributions of forest resources to livelihoods has been documented, and the role of forest products as a safety net – particularly those in extreme poverty and/or subject to severe income shocks – has been described ([Dewees et al. 2011](#_ENREF_7)). The values of wild foods, medicinal and genetic resources have not been documented in detail either across the Zambezi region or in any of the sub-regions under consideration. Indeed, very little information about such values is available across southern African region or even sub-Saharan Africa. However, the value of wild foods was calculated as being approximately six percent of total income (including ‘environmental income’) across income quintiles in a study of miombo woodlands in Zimbabwe, as presented in the main table ([Cavendish 1999](#_ENREF_4), [Cavendish 2000](#_ENREF_5)). Other studies have examined the contribution of forest resources to livelihoods, but have not published data regarding the specific contribution of wild foods ([e.g. Campbell et al 2002, Bwalya in prep., and Mutamba in prep., cited in Shackleton and Clarke 2007](#_ENREF_15)). [Lynam et al. (2003](#_ENREF_10)) in their study of woodland functions in Mozambique describe wild foods as contributing approximately 20% of total food input, but these resources can play an increasingly important role during climatic shocks such as drought and floods. These authors also discuss wild-harvested medicines, though do not determine the contribution to households, nor estimate a value of this harvest.

While many studies recognize the importance of regulating, supporting or cultural services, they rarely undertake specific valuations of such services, but typically examine a number of provisioning services ([Shackleton and Clarke 2007](#_ENREF_15)). The African ecosystem service valuation literature also includes studies that estimate a variety of values associated with alien invasive plants ([see for example, de Lange et al. 2013](#_ENREF_6)) and with ecological restoration ([see Blignaut et al. 2014 for a review](#_ENREF_3)). Other studies have valued specific ecosystem services ([O'Farrell et al. 2011](#_ENREF_13), [Bann and Wood 2012](#_ENREF_1)), or focus on particular biomes such as the Cape Floristic Region ([Turpie 2003](#_ENREF_20), [Turpie et al. 2003](#_ENREF_21)).

In some cases deficiencies in understanding underlying ecological processes results in difficulties in estimating the value of regulating and supporting ecosystem services (e.g. carbon storage in soils and above ground across sub-Saharan Africa) ([Stringer et al. 2012](#_ENREF_16)).

Unfortunately, the literature available largely undertake studies that are located in biomes very different from those found in the Zambezi region, and are limited in their usefulness in improving our understanding the values of cultural, regulating and supporting ecosystem services in the Zambezi region.

The estimates for carbon sequestration provided in the main table are drawn from the study of [Turpie et al. (2006](#_ENREF_18)) for the 56,000 km2 Okavango Delta Ramsar site. The study used published sequestration rates for different habitat types, and a carbon price of US$ 5 (BWP 27 per ton), and estimated that carbon sequestration function was worth about BWP 158 million for the entire Ramsar site; a value equal to BWP 28.42 per hectare. Using an exchange rate of BWP:NAD of 1.1609, this is equal to NAD 24.48 per hectare. The authors note that the results are very sensitive to the figures used for the carbon sink and carbon price, and that the uncertainty of the data used means the estimate should be used with caution.

At a much smaller scale, as part of his MSc thesis assessing the trade-offs between timber and carbon values of *Pterocarpus angolensis* (Kiaat) in the Kavango Region of Namibia, [Moses (2013](#_ENREF_12)) used market prices of NAD 65.47/tCO2 sequestration to value an ‘average’ Kiaat tree at NAD 123.61; or approximately one quarter the timber value of the tree.

The value of the Okavango Delta Ramsar site was also valued in terms of water purification, as wetland areas have the capacity to absorb or dilute wastewater, saving on treatment costs ([Turpie et al. 2006](#_ENREF_18)). The value was estimated by calculating the input of pollutants and estimating what the artificial treatment cost of this quantity of effluent would be. Because relatively little wastewater enters the wetland, the results indicate that the water purification value is a relatively modest BWP 2.2 million ([Turpie et al. 2006](#_ENREF_18)), which is equal to BWP 3.27 per hectare, or NAD 2.82 per hectare.

Finally, a study of the Zambezi Basin, [Turpie et al. (1998](#_ENREF_19)), estimated the value of a number of ecosystem services, as reported in Table 3 below, which is provided as an indication of value calculation. These calculations are approximately 15 years old, and it is not clear if or how these values have changed in the intervening period. Also, that part of Zambezi Region in Namibia makes up only a very small proportion of the entire Zambezi River Basin.

**Table 3: Ecosystem service values for the Zambezi Basin, as reported in Turpie et al 1998**

|  |  |  |  |
| --- | --- | --- | --- |
| **Indirect use** | **Method** | **Coverage** | **Estimated value (USD)** |
| Flood attenuation | Damage costs | Agriculture, personal losses, infrastructure | >3.1 million |
| Groundwater recharge | Replacement costs | Boreholes and shallow dug wells | >16.4 million |
| Sediment retention | Damage costs avoided for infrastructure |  | >8.9 million |
| Water purification | Replacement costs and costs of upgrading existing infrastructure | Waste and pollution | 44 million |
| Carbon sequestration |  |  | 110 million |

It should be stressed that despite the lack of valuation studies undertaken, this does not imply that these ecosystem services have no, or little, value. It has also been argued that the estimation of low values often do not adequately reflect the dependence of residents on ecosystem services ([e.g. O'Farrell et al. 2011](#_ENREF_13)), and that human need should be prioritized over valuation exercises ([Luck et al. 2009](#_ENREF_9)). Indeed, even if people do not currently derive utility from certain ecosystem services, these services still hold value simply from the preservation of the option to use these services in the future, either by individuals or by subsequent generations ([Millenium Ecosystem Assessment 2005](#_ENREF_11), [Pascual et al. 2010](#_ENREF_14)).

# Appendix D. Lessons learned

**1. INTRODUCTION**

The Strategic Environmental Assessment (SEA) of the Zambezi Integrated Regional Land Use Plan (IRLUP) was conducted in 2014-2015 by SAIEA, for the Ministry of Land Reform, Namibia. It was complemented by a specific add-on to the project, an assessment of the ecosystem services in Zambezi Region. This was intended to add to the information base for the SEA, and thereby inform the planning process with supplementary information on ecosystem services and their values.

Due to a number of unforeseen difficulties that involved staff unavailability, the ecosystem services component was not completed in time for it to contribute to the SEA and the IRLUP, and was only concluded after the SEA was completed.

This report is the outcome of a request from GIZ for SAIEA to document the lessons learned from integrating the Ecosystem Services work in the SEA, and how future SEAs for land use planning might benefit from its inclusion. This report should be read in conjunction with the Ecosystem Services Assessment for the SEA of the Zambezi IRLUP.

**2.** **OVERVIEW OF THE PROCESS FOR VALUATING ECOSYSTEM SERVICES**

The Terms of Reference for the ecosystem services assessment and valuation (ESAV) contributing to the SEA suggested a 9-step process for integrating ecosystem services into the SEA of the Zambezi IRLUP process (Slootweg 2015). The steps are indicated in the table below, with comments on the implementation.

|  |  |  |
| --- | --- | --- |
|  | **Step** | **Implementation in the SEA of the Zambezi Land Use Planning process**  |
| 1. | Define boundaries | Straightforward |
| 2. | Identify and map ecosystems | Simplified by recognising just two main ecosystems; woodlands and wetlands. Finer categorisation based on the vegetation is possible (such as *Burkea*-kiaat-false mopane woodlands, open camelthorn woodland etc.), but would not help since data on ecosystem services can’t be separated to these levels. People use the different services provided in the different areas but the services are provided from a range of vegetation types (e.g. Burkea-kiaat-false mopane woodland also provides some grazing). Separation of the services from each of these vegetation types would be very complicated, and probably not very instructive in the end. Therefore it was most practical to lump all woodland vegetation types together, and all wetland vegetation types together.  |
| 3. | Describe linkages with neighbouring areas | Movements of animals, people, nutrients from one ecosystem to the other were recognised in the discussions but the contribution of a service from one or the other was difficult or impossible to value. For example, livestock graze on the floodplains but they get moved into woodland areas during high water periods. The value of grazing is therefore derived from both ecosystems, but what is the proportion from wetlands and woodlands? Proportions were estimated, but more qualitative descriptions of these linkages would be useful.  |
| 4. | Identify and quantify ecosystem services for each ecosystem | A group of ecologists and people familiar with Zambezi Region were brought together in a workshop to assist. Criteria for selecting them were:* At least ten years of experience (not necessarily continuous residence) in the Region, so that trends could be discussed;
* Familiarity with the ecosystems, fauna and flora in the Region, and with ecosystem processes such as nutrient flows, recharge.
* Knowledge of rural livelihoods and the natural resources that are utilized or impacted by people, such as devil’s claw plants, livestock-wildlife conflicts.

The group included a resource economist so that he could advise on valuation aspects. This method was very constructive and helpful in identifying sources of data (e.g. recent study on use of veld foods by the San) and considering how proxy data could be used where local reliable information was missing. Field verification of this information was carried out during a week-long field trip in the Region. Interviews were carried out with individuals and organisations, and points raised in the workshop (e.g. deteriorating fisheries) were discussed. These meetings would have benefited from getting more information on non-monetary values, such as numbers of households using particular ESs.  |
| 5.  | Identify groups of stakeholders for each service | Straightforward, using the local knowledge in the workshop and information collected during interviews in the Region. |
| 6. | Quantify value for each group of stakeholders | It is difficult in a data-poor situation to split the contribution of services to different groups of people. Some qualitative partitioning was done, but the monetary value for each group of stakeholders was not possible. A greater effort should have been made to get data on other non-monetary values. |
| 7. | Baseline situation and trend for each service | Expert opinion was very useful here.  |
| 8. | Regulatory or policy frameworks applicable to ESs | These were noted and suggestions made for improving implementation or adjusting the regulations to better conserve various ESs. However, dedicated meetings with high-level decision-makers will be necessary to start any legislative or policy adjustments.  |
| 9. | Gaps in information | Many gaps were identified, both in the ecosystem information, and in the availability of economic data. Some proxy information (e.g. from the Okavango Swamps) was used. It is likely that there will be much more serious information gaps in less-studied ecosystems, such as the ephemeral pan system in Otjozondjupa Region. Therefore future ESAVs should be alert for any data that demonstrates the value of an ES, and not concentrate solely on compiling monetary values.  |

Most of the steps were accomplished, and they contributed to fulfilling the ecosystem services valuation. Step 3, identifying linkages with neighbouring areas, was useful but it was not possible to carry this through to the valuations. Simplifying the valuations to qualitative descriptions would have been more useful. Step 6, assigning values to the groups of stakeholders, was not achieved, as data on monetary value is not available at this level. Both these shortcomings were a result of the focus on monetary values. Other information reflecting value (such as contributions to food security, products sold on the market, safety from flooding, provision of fire wood or construction materials) should have been gathered.

The suggested format serves as a useful template for assessing ecosystem services elsewhere. However it must be noted that Zambezi Region is relatively well studied, since it is in this part of Namibia that community-based natural resource management has been most successful and most studied. This has brought relatively more attention to the social and economic aspects of the natural resources, than is the case elsewhere in Namibia.

**3. INCLUDING ECOSYSTEM SERVICES TO ASSESS DEVELOPMENT OPPORTUNITIES AND CONSTRAINTS**

The assessment of ecosystem services supplemented the information that was gathered in the SEA, and provided information that was used to identify development constraints. Two examples show how:

(i) Stakeholders at the IRLUP feedback meeting were unhappy with the SEA suggestion that areas along the Kwando River were not going to be earmarked for irrigation. The SEA indicated a ‘Red Flag’ here on the basis that (i) there was insufficient water in the Kwando River to allow abstraction for large-scale irrigation, and (ii) taking water out on the scale needed for irrigation would jeopardise the benefits derived downstream, such as fishing and tourism. The economic values calculated for these ecosystem services were not available at the time of this discussion, but the principles of opportunity costs and maintaining ecosystem health were used as arguments.

The outcome of the process was disappointing, as stakeholders were insistent that development opportunities should not be denied to them on the basis of ecological impacts that were not yet properly assessed. Nevertheless, the discussion was enriched by the information from the ecosystem services assessment.

(ii) On the basis of input from the SEA, the Zambezi IRLUP recommended that land should be allocated (as it already is) for wildlife-centred activities, by recognising the conservancies and State Protected Areas such as Mudumu and Nkasa Lupala National parks. This was met with considerable opposition during the IRLUP feedback meetings in October 2014 and February 2015, led predominantly by the livestock farmers who complained about the problems that wildlife bring to their activities (such as predation by lions and hyenas, and the presence of Foot-and-Mouth Disease which prevents them from moving or marketing their cattle).

An important contribution to resolving this impasse came from the Ecosystem Services assessment, which showed the considerable economic value derived from the tourism and recreation sector (N$226 million) compared to livestock grazing (N$27 million). The important lesson from the ESAV was that it showed the opportunities that the ecosystem offers.

**4. DATA AVAILABILITY**

This was a considerable constraint, and is likely to be even more of a problem in other areas of Namibia, since Zambezi Region has been a focus of attention for its achievements in community-based management of wildlife resources. Even with this attention on Zambezi, reliable economic data on aspects such as woodland resources, and revenue from wildlife and livestock, were scarce. This situation arises from the very few resource economists working in Namibia.

The lesson learned is that the ESAV must not restrict itself to monetary values. Other data can show value to people, such as number of households relying on a particular resource.

Consideration should be given, before commencement of the field work, to decide on what data should be gathered. Aspects that need to be considered include:

* Gathering adequate samples to be representative;
* How the data can show trends, to demonstrate sustainable use of the resources/services, or over-use that could lead to exhaustion;
* The need for the SEA to show information on alternative options for development.

**5.** **COMMUNICATING THE ECOSYSTEM SERVICES APPROACH TO LOCAL STAKEHOLDERS**

In our experience, any environmental work achieves its greatest influence on decision-makers and local stakeholders through the active work process, more than through the obligatory report which is compiled for the client as the main deliverable. The schedule of field work was specifically designed to meet local people such as the State Vet, the manager of a fish farm, a small-scale vegetable grower, the committee members of various conservancies, and members of the local farmers union. Time in the field also presented opportunities to discuss the IRLUP, SEA and ecosystem services with other random people such as an engineer involved in a local water supply project, and the owner and staff of local accommodation establishments. In addition, presentations at the IRLUP feedback meetings included ecosystem services, and gave exposure to the concept.

Each meeting, formal and opportunistic, was used to introduce the ecosystem services approach, to ‘dig’ for relevant information, and to raise awareness of ecosystem aspects. This information would not have become available without such field work, and the local people who participated in the discussions would possibly not have become aware of ecosystem services had the field work and presentations not been undertaken. It should not be viewed as ‘arrogant’ or ‘pushy’ to repeatedly talk about ecosystem services! On the contrary, it should be viewed as helping people to broaden their perspective and to consider issues that might impact them.

Another benefit from the ecosystem services assessment is that the team is required to visit and assess each ecosystem, and specifically consider its various components and functions. This might be considered to be a normal part of an SEA, but its implementation is ensured in the ES assessment. The field work provides time to physically experience the ecosystem and develop some familiarity with its processes. Also, photographs can be taken, which are useful for illustrating subsequent presentations to decision-makers and office-bound clients. The SEA consultant is expected to be familiar with the area and all its manifestations. Doing field work helps to achieve this, and gives credibility to the discussions in the land use planning process.

A shortcoming of the approach followed in the Zambezi ESAV was the focus on monetary values. This part was left to the two resource economists who worked on the project, and values were duly provided. However the calculations and statistical ‘massaging’ that were involved remain mysterious to most people. It would be useful, in future ES assessments, for the resource economists to more comprehensively explain the process and modelling to derive monetary values. In addition, values should be quantified in other ways, such as number of households or number of people benefitting, and how the benefits are distributed amongst different income levels of the local population.

Possibly the most important outcome of the ecosystem services approach is that it helps to influence any land use planning decisions to be ‘pro-poor’. It is the poor who most heavily rely on free services that a healthy ecosystem can provide. These hidden benefits are exposed and can be brought into the IRLUP process.

The lessons learned from this section are:

* Run the ESAV as early in the IRLUP process as possible.
* Ensure that the ESAV includes ample field work, allowing enough time to ‘absorb’ the various aspects of the ecosystems;
* Interview a wide variety of people who potentially use ecosystem services; try to reach all main users, and use all opportunities to dig for ES information;
* Use stakeholder meetings to introduce and explain the ecosystem services concept. Keep the message clear and simple;
* If economic valuation is applied then the methodology and statistical models applied should be communicated in a way that non-experts can understand.
* Values should be quantified in other non-monetary ways, such as number of households or number of people benefitting, and how the benefits are distributed amongst different income levels.
* Emphasise the value of ecosystem services as a safety net for relatively poor households.
* ESAV helps to understand people’s dependence on natural functions and processes. This should be elaborated into clear suggestions for land-use plans.

**6.** **INFLUENCING AND INFORMING THE LAND USE PLANNING PROCESS**

As described above, the ES approach helped, to a certain degree, to influence the land use planning process. Its greatest achievement was to convince decision-makers that the tourism sector was potentially very profitable for the Region. At the same time, and probably unsurprisingly, it was ineffective in persuading a group of cattle farmers to tolerate conservation land uses, which they viewed as conflicting with their own interests. But this in itself also emphasised the need to consider mitigation measures against wildlife conflicts.

The SEA practitioner must be fully familiar with the benefits that ecosystem services can provide. The indirect and often invisible benefits arising from a well functioning ecosystem need to be clearly explained. People sometimes have difficulty grasping concepts about ecological functioning, or they might not want to hear arguments which conflict with their own interests. The practitioner has to muster all her / his arguments, so a thorough understanding of ecosystem processes is necessary. The ES approach helps to systematically identify all the components of the ecosystem, and develop the knowledge to inform the planning process.

The lessons learned are:

* It is vital to have good communication methods, with clear messages that are appropriate for the various audiences. The results of the ES work have to be clearly communicated to local, community level people, as well as planners and decision-makers.
* Ensure that the results of the assessment are translated into clear messages that can be taken up in the land use planning process.

**7.** **TIMING OF THE ECOSYSTEM SERVICES ASSESSMENT**

The ES workshop was held on 3-4 July 2014, and the fieldwork was done from 20 – 25 of the same month. Both of these components ran after the Participatory Land Use Planning workshops had been conducted in the region, for local level inputs, during May 2015. The ES work was therefore done too late to be able to influence the local level planning discussions, where it would have been very valuable.

Nevertheless, the main part of the land use discussions took place during the Focus Group Discussions held in Windhoek from 29 July – 1 August 2015 (i.e. immediately after the ES field work). The familiarity with the Region and the ecosystem services provided useful content in the Focus Group Discussions, and many photographs taken during the ES field work were used in the presentations. The ES component therefore made valuable input to the high level planning that was done in Windhoek.

The lesson learned is that the ES field work should be conducted as early as possible in the SEA (see Figure 1), so that its information can be used in all the other components of the land use planning process. Participatory Land Use Planning (PLUP) workshops, and sector-level Focus Group Discussions, should be run only after the ecosystem services assessment has been properly completed and written up.

 

**8.** **PERCEPTIONS OF ECOSYSTEM SERVICES BY STAKEHOLDERS AND BY EXPERTS**

As described in Section 4 above, the ecosystem service argument that was used to criticise the suggestion for irrigation projects along the Kwando River, was not well received. Farmers had been promised that irrigation projects would be established, during a visit from the Minister of Agriculture, Water and Forestry, a few years earlier. Their expectation was now for the irrigation projects to be facilitated, rather than opposed, by the land use planning process.

The stakeholders were angry that a project might be prevented on the basis of environmental factors. Ecosystem services were viewed as an obstacle to what they perceived as their right. This impasse was resolved by assuring stakeholders that the proposed irrigation project, although not recommended by the SEA, would not be scrapped entirely. It would still need to be subjected to a feasibility study, and only then would a pronouncement be made about the project.

This example created a negative perception of the SEA and ESs, by the group of stakeholders who were most vocal about their needs as farmers.

The perception of ESs by other people involved in the land use planning process was neutral to positive. Participants in the Focus Group Discussions recognised the importance of ecological factors, and there was no opposition to the arguments about ecological processes. However, the actual values of what each sector was worth were not available at the time of the FGDs.

The lesson learned is that environmental considerations can easily be overruled by politics and people pressure. The land use plan might not include every recommendation of the SEA for sustainable development. This highlights the need to make the case for ecosystem services as strong as possible. The value of ecosystem services must be stated in a variety of ways, such as livelihoods, benefits to local people, and other ways that decision makes can relate to. Even if this is bypassed in the land use planning process, the information is still relevant for future development planning.

**9. CHALLENGES FEEDING THIS APPROACH INTO THE POLITICAL PROCESS**

The conservation, wildlife and tourism sector is often perceived to be in opposition to other sectors because it is seen as putting the brakes on development plans. People think that projects that might bring immediate benefits such as employment and trade opportunities, might be stopped when their negative environmental impacts are pointed out. Against this background, the main benefit of the Zambezi ES work was its role in convincing the Traditional Authorities and the Regional Council staff, led by the Governor, that tourism was potentially a profitable land use.

The SEA of an IRLUP should consider alternative development scenarios. This should include the role that various ecosystem services play, and how they influence development opportunities in the region. The ESAV can help to show how different land uses might benefit people, especially if the services help them to step out of poverty. If suggested land use are likely to carry strong negative impacts, this can be explained in terms of the costs of ecosystem services that might no longer function.

An ESAV can help decision-makers realise the benefits of a healthy environment. The ES approach should show the benefits in terms of livelihoods or monetary values. Presentations should be attractive and interesting, with photographs of local scenes and local people, to help people see the connection between the resources in their surroundings (which might be taken for granted) and the ecological processes that keep them that way. For example, fish are very important to local livelihoods in Zambezi Region. Fish populations depend on factors such as good quality water in the rivers, and sporadic flooding that gives them the opportunity to breed in floodplains. Irrigation projects can jeopardise these features. People might recognise these connections, but not be willing to accept that irrigation projects should be scaled down or scrapped. This is where arguments based on monetary values or numbers of people making a living from fisheries can be useful.

The lesson learned is that some effort needs to be made to achieve political buy-in, by working through well established political forums. For instance, it would be useful to secure an appointment with a body such as the Regional Development Coordinating Committee. A specific presentation on the Region’s ecosystems, and the free services that they provide, might help political leaders to understand their value. The fact that sustaining ecosystem services is a ‘pro-poor’ strategy should be emphasised.

 **10. RECOMMENDATIONS FOR INCLUDING ECOSYSTEM SERVICES IN SEA**

The ecosystem services approach in Zambezi teaches us the following lessons:

**10.1 Field assessment**

* Do the ES assessment as early as possible in an SEA, so that its results can be used in all subsequent planning discussions (see Figure 1). Ensure that the assessment includes ample field work, allowing enough time to ‘absorb’ the various aspects of the ecosystems.
* Coordinate the scheduling of the ES work with the client (MLR) and the other consultants (planners, mappers). The assessment can achieve its greatest influence if the other components of the IRLUP process, particularly the Participatory Land Use Planning meetings, follow after the ES field work.
* Plan what sort of data will be gathered. Consider ways to express the value of ecosystem services in ways that people can understand, and in ways that will be quantifiable. Therefore it should not be restricted only to monetary values. Other quantitative and qualitative data can show value to people, such as number of households relying on a particular resource, contributions to food security, price of the goods on the market, how the service reduces risks, frequency of use of materials such as fire wood or construction materials.
* With respect to data, aspects that need to be considered include:
	+ Gathering adequate samples to be representative;
	+ How the data can show trends, to demonstrate sustainable use of the resources/services, or over-use that could lead to exhaustion;
	+ The need for the SEA to show information on alternative options for development.
* Use maps to visualize ecosystem service users and providers. For instance, the 1:250,000 topo-cadastral maps show the important geographical features, which are also important in an ecological sense. Where possible, add features which are relevant to ecosystem services. E.g. location of livestock marketing points (auction kraals, bush markets, abattoir); areas of bush encroachment; selling of woodland products (e.g. thatch, poles, charcoal, wooden crafts); fish markets. Record GPS coordinates for all these places during the field work, and include them where relevant in the mapped information.
* Take as many photos as you can when doing the ES fieldwork. Pictures make a great addition to the presentations that will be necessary to explain environmental features and their link to livelihoods.
* Arrange appointments with as many local representatives of the regional economy, as possible, to dig out ES information. This might include local farmers groups, conservation experts, tourism operators, agriculture extension officers, health inspectors, civil society organisations, etc. Learn about what resources they need, what obstacles they face, how they deal with problems.

**10.2 Compilation of ES information to influence the IRLUP process**

* Present the opportunities and synergies that arise from ecosystem services, so that they can influence the land use planning process. Suggestions for economic activities and particular land uses should be introduced, motivated by the livelihood and/or economic values that they could create.
* Present alternative development scenarios that take into account the role ecosystem services play.

**10.3 Communication**

* If economic valuation is applied, then the methodology and statistical models used should be communicated in a way that non-experts can understand. The value of ecosystem services must be stated in a variety of ways, such as livelihoods, benefits to local people, and other ways that decision makes can relate to.
* Try to maximise political buy-in by sharing the ES information. For instance, make an appointment with the regional authorities (e.g. Regional Council, Regional Development Coordinating Committee, Traditional Authorities) to present the findings of the ES assessment. Emphasise the value of ecosystem services as a safety net for relatively poor households, so that the relevance of the work as being ‘pro-poor’ is understood.
* Make the ES information appropriate for the target audiences. Keep presentations simple and clear, with plenty of photographs linking features of the ecosystems with livelihoods, employment and the economy. Show people involved in day-to-day activities. Show examples of various local plants and animals, and discuss what their requirements are, and how they contribute to ecological processes. Describe the benefits that arise from them, and the monetary values that are derived from them. Show features that have a negative impact, such as pollution, bush encroachment, wastage of water. Use headlines from newspaper articles to show how issues are relevant to local interests. The presentation should have just a few (maximum 5) main messages, with a clear conclusion about the issues and what should be done.
* Local stakeholders and authorities do not need to recognise the different categories of services, namely provisioning, cultural, regulatory. So it is not worth spending time describing the categories e.g. by motivating why tourism is classified as a different service from food provision. The important principle is that people should be made aware of the goods and services that they use from the natural environment, and what they need to do to sustain them.

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1. ([Turpie et al. 2006](#_ENREF_5)). Conversion calculated at BWP/NAD 1.1609, as was the average for 2006. [↑](#footnote-ref-1)
2. ([Moses 2013](#_ENREF_3)). [↑](#footnote-ref-2)
3. ([Cavendish 1999](#_ENREF_1), [Cavendish 2000](#_ENREF_2)). [↑](#footnote-ref-3)
4. ([Turpie et al. 2006](#_ENREF_5)). Conversion calculated at BWP/NAD 1.1609, as was the average for 2006. [↑](#footnote-ref-4)
5. ([Moses 2013](#_ENREF_3)). [↑](#footnote-ref-5)
6. ([Turpie et al. 2006](#_ENREF_5)). Conversion calculated at BWP/NAD 1.1609, which was the average for 2006 when the estimate was derived. [↑](#footnote-ref-6)
7. ([Cavendish 1999](#_ENREF_1)). [↑](#footnote-ref-7)
8. ([Cavendish 2000](#_ENREF_2)). [↑](#footnote-ref-8)
9. ([Turpie et al. 2006](#_ENREF_5)). Conversion calculated at BWP/NAD 1.1609, as was the average for 2006. [↑](#footnote-ref-9)