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EXECUTIVE SUMMARY

Introduction

The Okavango Delta, located in northwestern Botswana, is an internationally renowned natural wonder of international biodiversity significance that also plays a key role in the economy of Botswana. A large inland delta, the sink of the Okavango River, the delta was listed as a wetland of international importance in 1997, under the Ramsar Convention. In order to ensure the delta's conservation and wise use, the Okavango Delta Management Plan (ODMP) is under development. This process is aimed at integration of resource management for the Okavango Delta that will ensure its long term conservation and that will provide benefits for the present and future well being of the people, through sustainable use of its natural resources.

The ODMP is trying to assess the fundamental linkages and interdependencies between the hydrological functioning of the Delta, its ecology and the economy these support. DWA is currently modelling the hydrological functioning of the Delta and from this work, planners should be able to determine how the water flows now, what the extent and shape of flooding is annually and how this might change under various scenarios, such as climate change, increased abstraction, channel blockage and clearance etc. Many of the other component parts of the ODMP are also collecting information on the ecology of the Delta and its economy, e.g. use of veld products, community based natural resources management (CBNRM), fisheries, tourism, etc.

The World Conservation Union (IUCN) is supporting the development of the ODMP, as part of the Water and Nature Initiative in Southern Africa. Part of the contribution of IUCN is to provide technical support to elements of the management plan development exercise, and in particular IUCN is targeted to provide support towards formulation of a vision, review of policy, and carrying out an economic valuation study of the Okavango Delta in conjunction with DEA.

The aim of the economic valuation study is to inform management planning and practice, in the context of current and future activities being carried out under ODMP and other agencies, working towards conservation and sustainable management of the Delta's natural resources, and responding to the current and future threats to the Delta. These include unsustainable land use and resource exploitation, inadequate freshwater flows, habitat conversion and modification, invasive species, inequitable benefit sharing and lack of local economic incentives for conservation, unsupportive macroeconomic and sectoral policies, insufficient budget and financial support. While this study is not comprehensive, it will be able to provide much of the information required. This study builds on the considerable volume of work that has been done the past in various contexts to determine the economic value of goods and services associated with the Okavango Delta.

The overall objective of this study is to determine the economic value of the environmental goods and services of the Okavango Delta in order to evaluate the implications of a number of management and resource allocation options for the area. The report also provides recommendations that have a sound economic basis, which will help to ensure future sustainable use of the Okavango Delta.

Study area

The Okavango Delta is situated at the northern most edge of the Kalahari sandveld in north western Botswana, below the Caprivi Strip in Namibia. It is the largest designated inland wetland in the world and is fed by the water of the Okavango River with between 5-16 thousand million cubic metres of water per annum from the river's headwaters in Angola. This study was concentrated within the boundaries of the Okavango Delta Ramsar site, which encompasses the entire delta and surrounding upland areas. The Ramsar site covers a total of 55 599 km^2, and the Okavango Delta (the wetland area) covers some 13 000 km^2 within this.

The study area is for the most part a vast, very gently undulating plain, apart from slightly elevated areas in the extreme west. It is located in a semi-arid region which has hot, wet summers and cold, dry winters. Rainfall occurs mainly in November to March, with an average of 500mm per annum. Evaporation is 5 – 6 times higher and accounts for 95% of water loss from the delta.

From where it enters Botswana, the Okavango River flows in a south easterly direction for just over 100 km before fanning out into the delta proper. This section of river is known as the Panhandle. After travelling down the panhandle the water is then distributed over three primary channels (Thaoge, Jao-Boro and Maunachira-Khwai) and thence into numerous smaller channels and floodplain areas. The delta ecosystem ranges from perennial swamps to dryland areas, which include a large arid island (Chief's Island) in the middle of the delta. The zonation of land types has been described in different ways. The ODMP, which describes the entire Ramsar Site, recognise five land categories: water (Pan-handle), normally flooded, seasonally flooded, occasionally flooded and rarely flooded areas.

The pattern of flooding is roughly inverse to the pattern of rainfall. Floodwaters from the catchment area reach the top of the panhandle in about April, and take several months to reach the distal portions of the delta, finally reaching Maun in the late dry season (August to October). As the floodwaters proceed, the delta expands from about 5000km^2 to between 6000 and 12 000km^2, depending on the size of the flood. Very little contribution is made by local rainfall. There have been changes in the distribution and amount of flooding over time, possibly due to increased evaporation, declining rainfall in the catchment, and tectonic activity.

The soils of the study area are predominantly arenosols in the delta and Kalahari sands in the dryland areas. There is no significant agricultural potential in the Ramsar site. Vegetation of the delta is a mosaic of perennial swamps, seasonally flooded open grasslands, woodlands and palm-fringed islands with forests. It is surrounded by mopane woodlands to the north east and acacia woodlands to the south west. The delta is a low nutrient system, although there are areas of relatively high productivity. Overall faunal diversity is fairly high, with some 80 species of fish, some 115 species of mammals and over 500 species of birds, but few species are endemic to the area. Local level diversity and densities are typically quite low. Nevertheless, the delta supports a high biomass of large herbivores, mainly due to the high numbers of elephant. Within the Ramsar site, wildlife populations are concentrated in the delta, and within the delta, they are concentrated in Moremi Game Reserve, which is managed by the Department of Wildlife and National Parks (DWNP). Several species are largely confined to the permanently wet areas of the delta.

Within the Ramsar site, all but 4.6% of land is under tribal land tenure, the remainder being state land, and there is no freehold land in this area. Usage rights are granted to Botswana citizens either communally or to individuals, usually for residential purposes, ploughing or boreholes. These rights are typically passed on through generations. In addition, citizens and non-citizens can acquire 50-year leases for commercial and industrial developments. Land cannot be sold, but the improvements or developments can.

Ngamiland District is divided into 52 Controlled Hunting Areas of which 37 fall within the Ramsar Site. These are zoned as livestock, wildlife or multi-purpose (parstoral/arable/residential) areas. About half the study area, mainly within the delta, is under wildlife utilisation, with 9.4% in protected areas and 41.8% designated as Wildlife Management Areas (WMAs). WMAs can be either commercial (leasehold) or community-based (managed by community trusts), and can be for wildlife utilisation or photographic purposes. The remaining 48.8% is communal land area containing settlements, arable lands (mainly subsistence fields) and dominated by grazing lands. The distribution of cattle is limited by a cordon fence, with most of the delta being a cattle-free zone.

Originally populated by the San, there is considerable ethnic diversity in the study area. The main groups are the Bayei, primarily fisher-farmers, the Hambukushu, primarily fishers, the Batawana, mainy livestock and dryland farmers, and the Baherero, primarily pastoralists. Refugees from Angola have also settled in the area in recent decades, introducing basket-making skills. The population is concentrated around the edge of the delta, along main roads. Half the population is in Maun and the remainder is largely concentrated around the Panhandle. There are at least 67 settlements, most of which contain fewer than 1000 people. In 2001 the population was about 111 000 people in 18 300 huseholds. Children make up 53% and the elderly only 6%. Life expectancy is dropping mainly due to HIV/AIDS and 55% of households are female-headed. Most people are rural and poor, and have diversified production systems to reduce risks in an unstable environment.

For the purposes of this study, the study area was divided into five zones, based on consideration of settlement patterns, land use and natural resource characteristics (Figure I):

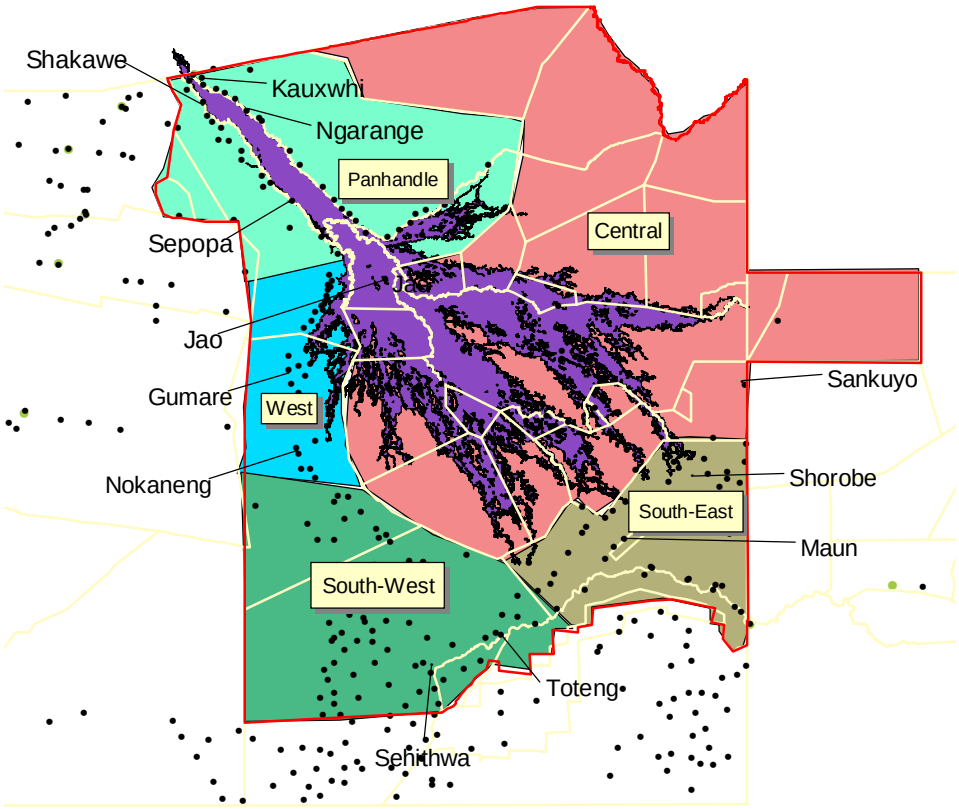

Figure I. Five zones defined for the study area

The Panhandle zone is characterised by the lack of floodplain area, the high numbers of settlements along the river, and the relatively high density and accessibility of fish and aquatic plant resources. There is little opportunity for recession agriculture (molapo farming). The West zone is characterised by numerous settlements and access to wetland and floodplain resources, including molapo farming areas. The South-west zone is relatively arid and sparsely populated. Its settlements follow what was formerly the outer margins of the delta, but these are now far from the wetland and floodplain areas. The South-east area is dominated by Maun and is relatively far from the main wetland areas, but does have reasonable access to some of the distributaries and floodplain areas. The Central zone is largely delineated on the basis of the buffalo fence and has wildlife as the main land use. This zone encompasses most of the wetland area, and there is very little upland area. While dominated by the Okavango Delta, it also includes the Linyanti-Chobe wetland areas on the north-eastern border of the study area. There are very few people living in this zone, in a few scattered villages as well as in association with some of the larger tourist lodges.

The population of each of the zones is summarised in Table I. Ethnic composition differs markedly between the zones. Based on the sample from this study, the Panhandle is dominated by the Bahambakushu, the South West is dominated by Batawana and characterised by a high proportion of Baherero, and the remaining zones (West, Central and South East) are dominated by Bayeyi.

Table I. Population of the zones

Zone	Population 2001	Household size (this study)	Estimated number of households
Panhandle	25,483	7.2	3,531
West	17,108	8.3	2,056
South West	9,193	7.5	1,226
South East	53,497	8.3	6,412
Central	1,475	7.3	202
Total	106,756		13,427

Approach and valuation framework

The study builds on considerable work that has been carried out in the study area, as well as primary data collection using surveys. The study was conducted using both a Total Economic Value (TEV) framework and a National Accounting framework.

The TEV framework was slightly modified to define four different types of values considered in this study:

- tourism value (both consumptive and non-consumptive direct use value);
- natural resource use by households (a consumptive use value);
- indirect use value (values generated beyond the study area due to services provided by the study area); and
- non-use value (option and existence value).

Tourism value was estimated on the basis of existing information only. An inventory of tourism enterprises was complied. Three types of enterprise models were developed or used in the study: a typical ecotourism lodge, a safari hunting enterprise, and a community-based natural resource management (CBNRM) model in which a tourism operation enters into agreement with a local community for use of their resources. Using the models in conjunction with the inventory and expert opinion, three methods were used to estimate turnover in the accommodation sector which provided a range of plausible estimates. A portion of this turnover was then attributed to the delta, using defined ratios for different types of enterprises. Turnover values were divided into non-consumptive tourism, safari hunting tourism, and CBNRM. Turnover in related sectors (e.g. expenditure on airfares) was estimated using ratios from a previous study of tourism in the area. Direct value added was calculated based on the turnover to direct value added ratios in the enterprise models.

Household use of resources was quantified using primary data collected in a survey of 430 households in all five zones of the study area. The household questionnaire elicited information on household demographics, the relative importance of different sources of income, the quantities of natural resources harvested and value added, and on agricultural production. General information on agriculture and use of natural resources, such as seasonality, input prices etc. was gleaned during focus group discussions and key informant interviews in each of the zones. Information collected in the survey was supplemented with existing information and used to construct a household production model to calculate the gross and net private value of different activities to households in each zone.

Five main ecosystem functions were identified as being important in the generation of indirect use value: groundwater recharge, wildlife refuge, carbon sequestration, water purification and scientific and educational value. Recharge value was estimated as the value of groundwater abstraction immediately around the wetland. Carbon sequestration was estimated using published rates of sequestration applied to different habitat types, and using published values of carbon. Wildlife refuge value was estimated by estimating the hunting value of animals that were hunted beyond the delta but whose presence in those areas was attributed to the delta. Water purification value was estimated by calculating the input of pollutants and estimating what the artificial treatment cost of this quantity of effluent would be. Scientific and recreational value was estimated on the basis of the expenditure on these activities in the study area.

Measurement of option and existence value was beyond the scope of this study, but a short discussion on these values was included. A national accounting framework was then used to estimate the impact of the direct use values described above on the national economy. Total Economic Value was estimated in terms of direct gross output, direct contrition to national product and economic resource rents. Direct impact on rural livelihoods in particular was estimated in terms of the income generated by agriculture, natural resource harvesting and through tourism. The macro-economic impacts were estimated by taking the backward and forward linkages into account using a Social Accounting Matrix. Finally, the capital value or natural asset value of the Okavango Delta was estimated as the net present value of the economic rent generated from the asset base.

Following the estimation of current value of the study area, a coarse-level scenario analysis was carried out in order to test the potential implications of different management policies on the economic value of the study area.

Direct use value: tourism

The wildlife-based tourism industry is now Botswana's second largest income earner after diamond mining, contributing 5.0% to the country's Gross Domestic Product and providing 40% of employment in northern Botswana. Botswana's first Tourism Policy (1990) pursued a high value/low volume tourism strategy which has been very successful in the north.

Tourism in the Okavango delta has grown dramatically since the 1970s when it was almost non-existent. Tourism is centred on the Moremi Game Reserve and surrounding WMAs, and access is via Maun. Moremi receives about 40 - 50 000 visitors, numbers being influenced by regional and global politics. Visitors stay in DWNP or private camps. In the WMAs outside Moremi, visitors stay in photographic safari camps, hunting camps or fishing camps, the first of which are generally the most luxurious. All the camps are temporary structures. Camp owners either pay a lease (a percentage of turnover) to the local government land board (for commercial WMAs) or to the communities, as well as royalties for hunting. Several WMAs were assigned as community management areas under Botswana's CBNRM programme. These communities apply to the DWNP for a hunting quota. These communities then enter into joint venture agreements with commercial operators, or they may opt to simply auction their hunting quota to safari hunters or companies.

Tourism in the delta is strongly seasonal, with high season being from July to October. This is reflected in price differences and occupancy levels. Overall, the study area is estimated to generate a gross income of some P1 115 million, making a direct contribution of P401 million in terms of direct value to gross domestic product (GDP). About 99% of this is attributed to the delta. An estimated 80.0% of tourism value accrues to photographic tourism companies, 15.5% to hunting safari companies, and 3.5% accrues to communities through CBNRM arrangements.

Direct use value: household use of natural resources

Households in the study area are typically fairly large, with an average of 7.2 to 8.3 people per household, depending on the zone. About 21-34% of adults are formally employed, with tourism and DWNP accounting for a large proportion of jobs, particularly in the central zone (60%) and South East zone (19%). Households have 3 to 4 dwellings on average, a large proportion of which are built with modern materials (20 – 49%). Most households rely on paraffin for lighting and firewood for cooking.

Most households are engaged in agriculture, either pastoralism, dryland farming, or molapo farming or a combination. Livestock is considered to be the most important agricultural activity, providing cash income as well as meat, milk, draught power, wealth store and social status. Livestock tend to be kept at cattle posts, where they are less susceptible to disease and cause less damage to crops, but some households keep small herds in the villages. Households with livestock at cattle posts have larger herds, with an average of 32 cattle, 28 small stock, and 6 donkeys/horses. In comparison, those that keep their livestock in the village have an average of less than 5 cattle, 16 small stock, and 3 donkeys/horses. Overall, the value of cattle is estimated to be some P29 million in terms of net income, with an estimated direct economic value of about P34 million. 88% of the net income and 83% of the economic value is derived from cattle posts.

Some 75% of households in the study area are crop farmers. About 47% of households have dryland fields, and a further 28% have molapo fields, and dryland fields make up about 80% of the area planted. Fields are small and dryland and molapo fields were not significantly different in size per household but production per unit area is considerably higher on molapo fields than on dryland fields. It was estimated that about 14 500 ha were planted in the study area in the 2004/5 crop season. Note that this was a dry year, and the area may increase in wetter years. The main crops grown are maize and sorghum (staples), and millet (mainly for beer brewing), which are sown together with a variety of other crops such as groundnuts and beans. Dryland and molapo farming are worth about P6.5 million and P2.6 million in net income to households in the study area, respectively, with relatively little of this being translated into cash income.

A large number of natural resources are utilised, many of these being used by a high proportion of households in each area (Table II).

Table II. Percentage of households engaged in different natural resource-related activities (household survey data).

Activity	Panhandle	West	South West	South East	Central
Firewood	77	86	98	85	96
Wild foods	57	53	64	57	65
Hunting*	36	49	43	42	61
Poles & withies	49	28	34	28	47
Reeds	69	33	7	18	22
Palm leaves	12	42	7	29	41
Wetland grasses	61	21	2	5	18
Upland grasses	8	12	18	16	35
Fish	34	6	4	6	20
Medicinal plants	12	12	19	16	10
Papyrus	10	1	0	1	12
Honey	2	1	1	2	2
Pottery	3	0	2	1	0
Timber	1	1	0	1	0

*assuming a 10% reporting rate

Firewood is the most commonly-used resource, harvested by most households. An estimated 1.76 million bundles are harvested annually. Wild plant and animal foods are next most commonly used resources, with an estimated total annual harvest of some 280 tonnes of plant foods and 160 tonnes of wild meat. Raw materials are generally next most important in terms of the proportion of households involved, particularly poles, reeds, and grasses, which are used in the construction of household dwellings. Some 276 000 poles, 150 000 bundles of reeds and 174 000 bundles of grass are harvested annually in the study area, with reeds and a portion of grasses coming from the wetland. Although locally very abundant in the delta, papyrus is only really accessible to households in the panhandle and central areas, and is used by relatively few households, with a total harvest of about 2300 bundles. Palm leaves are harvested by many households, particularly for the production of crafts. Over 9000 bundles are harvested, and some 36 500 products (mainly baskets) are produced from a combination of grass and palm leaves as well as natural dyes. Fishing is practiced by up to 34% of households in the panhandle and central areas. This is the largest fishery in Botswana, with an estimated total of 3570 fishers and an estimated total catch of about 450 tons. Medicinal plant use is significant but relatively uncommon, and production of timber, pottery and honey are uncommon.

The total annual private use values derived from agriculture and natural resources in the study area, including the value added in processing, is summarised in Table III. Just over 30% of the value of agriculture plus natural resource use can be attributed to the delta. The total direct use value of the Ramsar site, and the portion of that value that can be attributed to the delta or wetland area, is summarised in Table IV.

Table III. Summary of the annual private values associated with household natural resources use and agricultural activities in the five zones of the Ramsar site and the contribution of the wetland itself (Pula, 2005)

	Pan-handle	West	South West	South East	Central	TOTAL
Livestock	9 507 254	17 071 621	9 407 181	25 142 602	37 173	61 165 831
Upland crops	1 797 892	332 514	319 151	1 733 447	-	4 183 004
Molapo crops	43 375	1 350 992	129 373	644 534	23 377	2 191 651
Upland resources	4 455 802	2 647 276	1 603 807	7 818 836	1 439 804	17 965 525
Wetland plants	2 727 891	1 554 821	91 199	2 834 808	63 856	7 272 574
Fish	2 253 711	20 766	10 639	263 441	116 963	2 665 520
Wetland Birds	8 860	18 073	-9 558	-68 976	-	-51 601
Total Ramsar Site	**20 794 785**	**22 996 062**	**11 551 793**	**38 368 692**	**1 681 173**	**95 392 505**
Total from wetland	**5 009 113**	**14 978 302**	**147 910**	**9 592 073**	**190 871**	**29 918 270**

Table IV. Total household direct use value of the Okavango Delta Ramsar Site and of the delta itself

	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
Livestock production	79,246,782	61,165,831	43,606,492	83,209,121	39,757,628
Crop production	8,629,992	6,389,500	1,061,293	9,030,989	2,768,533
Upland resources	18 434 658	17 487 031	3 882 628	19 356 388	17 395 441
Wetland resources	10 659 593	9 881 189	3 407 419	11 192 572	10 310 168
Total	**29 094 251**	**27 368 220**	**7 290 047**	**30 548 960**	**27 705 609**
Total value attributed to delta*	**10 659 593**	**9 881 189**	**3 407 419**	**11 192 572**	**10 310 168**
%	37%	36%	47%	37%	37%

*includes a portion of livestock and molapo production.

Indirect use value

Five main ecosystem services were valued as follows:

Groundwater recharge: The Okavango Delta provides a conduit for the recharge of groundwater aquifers which are utilised around the perimeter of the wetland. Some 5.8 Mm^3 of groundwater is extracted from the study area, worth an estimated P16 million.

Carbon sequestration: Vegetation sequesters carbon, which contributes to the amelioration of damage caused by climate change by reducing atmospheric carbon. Based on published values and sequestration rates obtained from the literature for different habitat types in the study area, it is estimated that the carbon sequestration function is worth about P86 million in the delta and P158 million for the entire Ramsar site.

Wildlife refuge: The Okavango Delta (and Chobe) wetlands provide refuge for certain wildlife species that migrate to other parts of the Ramsar site and beyond, generating benefits and use value in those areas. The value of use of these species used beyond the wetland area is estimated to be P77 million. Of this use beyond the entire Ramsar site is about P30million.

Water purification: the wetland area has the capacity to absorb or dilute wastewater, thus saving on treatment costs. Relatively little wastewater finds its way into the wetland, however, and the service is valued at about P2.2 million.

Scientific and educational value: The wetland and the ODRC are frequently used for research and educational purposes. Based on the expenditure involved, the annual scientific and educational value is estimated to be at least P24 million for the Ramsar site, of which P18 million is attributed to the wetland.

Option and non-use value

No studies have been conducted to estimate the option and existence value of the study area or the Okavango delta. It has been estimated that tourist to the delta alone have a willingness to pay to preserve the area of at least P13 million (net present value). However, this provides a distorted view since the national and global willingness to pay to preserve this internationally renowned feature is likely to be orders of magnitude higher. Further research is needed in order to highlight the full trade-offs made in policy decisions.

The value of the Okavango Delta in the economy of Botswana

The Okavango Delta generates an estimated P1.03 million in terms of gross output, P380 000 in terms of value added to gross national product (GNP) and P210 000 in resource rent. The direct use

values of the Okavango delta are overwhelmingly dominated by the use of natural wetland assets for tourism activities in the central zone. Households in and around the delta earn a total of P225 million per year from natural resource use, sales, salaries and wages in the tourism industry, and rents and royalties in CBNRM arrangements. The total impact of the direct use of the resources of the Ramsar site is estimated to be P1.18 million in terms of contribution to GNP, of which P0.96 million is derived from use of the wetland itself. The multiplier effect is greater for the formal sector than for the poorer components in society, because the former activities have greater backward linkages and households are primarily engaged in subsistence activities. The natural capital asset value of the Ramsar site is estimated to be about P3.9 billion, of which the Okavango Delta is worth P3.4 billion.

Implications for future management: a scenario analysis

While an understanding of the total economic value of the delta is potentially useful for lobbying for conservation support, consideration of how this value might change under different management or policy scenarios is potentially a far more useful undertaking for decision-makers. A very rough scenario analysis was undertaken to investigate the possible implications of some possible future management options:

1. Agricultural expansion, in which the veterinary fence is moved back and grazing is expanded into the wetland area, precluding some communal and commercial hunting activities in those areas;
2. Expanded protection, in which consumptive use of resources is not allowed within the delta wetland area;
3. Wise use, based on Ramsar planning guidelines, in which resource use is carefully managed and there is limited tourism expansion;
4. Wise use under a scenario of upstream water abstraction, is as above but with the impacts of reduced flow in the delta; and
5. Wise use under climate change, is as above but with the much greater impacts of reduced rainfall in the catchment.

The results of the analysis are summarised in Table V.

Table V. Estimated outcomes in terms of direct value added, or general value, attributable to the Ramsar Site and the wetland, following five different scenarios. Note that estimates are rough.

Scenario	Present	1. Agriculture	2. Protection	3. Wise use	4. Abstraction	5. Climate change
Ramsar site						
Tourism	514 100 000	471 100 000	487 920 000	568 545 000	481 850 000	379 030 000
Household use	70 231 769	70 532 221	57 520 039	70 629 294	68 297 910	63 181 679
Indirect use	High	High	V high	V high	Medium	Low
Existence	High	Medium	V high	**High**	Medium	Low
Wetland						
Tourism	461 520 000	431 420 000	463 524 000	519 961 500	438 945 000	346 641 000
Household use	18 989 980	17 936 907	8 189 818	19 389 135	17 753 028	14 484 703
Indirect use	High	High	V high	V high	Medium	Low
Existence	High	Medium	V high	**High**	Medium	Low

Conclusions and recommendations

Management of the Okavango Delta and the Ramsar Site in general will need to strike a balance between meeting the needs of the people living in and around the delta and generating its important contribution to the national economy. People living in the study area derive roughly equal benefits from natural resources and from tourism, the latter being slightly higher. However, there is an important difference in the form that these benefits take. Natural resources provide subsistence value which contributes to peoples' livelihoods, as well as some cash income. Perhaps more importantly, they have the capacity to provide a safety-net for households that suffer shocks and provide a risk-spreading mechanism for poor households that are vulnerable to the vagaries of environmental variability. Tourism, on the other hand, generates hard, reliable cash income to households, providing

the type of income that most households aspire to having. Thus both aspects are important. Tourism also makes a substantial contribution to Botswana's GNP, which in turn provides more revenue and social security to households all over the country. In the light of the above findings, it is recommended that future management of the Okavango Delta is centred on ensuring the sustainability of current resource use by households so that they can continue to provide the livelihood and other social benefits into the future, and enhancing the value of the delta for low impact – high value tourism through maintaining the extent and integrity of the conserved area. The enormous value of tourism in the Okavango Delta could be turned to greater advantage if policy aimed to reduce the import component of tourism and to expand the links between tourism and development through CBNRM. Given the massive potential influence of changes in freshwater inflow into the delta on the capacity to generate both household and tourism benefits, and the potential effects of climate change in exacerbating any impacts of upstream water abstraction, it is essential that Botswana works to ensure adequate flows in future through international agreements.

Finally, we recommend that there is ongoing research on ecosystem functioning of the delta that will be able to inform our understanding of the value of ecosystem services and the impacts of finer scale management decisions. Research is needed on tourism in order to understand the mechanisms of demand and supply and the impacts of various policy decisions. In addition, more research is required on the non-use value generated by the delta in order to appreciate the impact of changes in ecosystem health of the delta on the international community.

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LIST OF ABBREVIATIONS AND ACRONYMS

ARB	Agricultural Resources Board
B&B	bed-and-breakfast (accommodation)
Bm^3	billion cubic metres
BNWMP	Botswana National Water Master Plan
BoP	Balance of payments
CBNRM	community based natural resources management
CGE	computable general equilibrium
CHA	Controlled Hunting Area
CMA	community management area
CVM	contingent valuation method
DAHP	Department of Animal Health and Production
DEA	Department of Environmental Affairs
DLUPU	District Land Use Planning Unit
DoT	Department of Tourism
DTRP	Department of Town and Regional Planning
DWA	Department of Water Affairs
DWNP	Department of Wildlife and National Parks
ERHIP	Every River has its People
FAO	Food and Agriculture Organisation of the United Nations
FAP	Financial Assistance Program
GDP	gross domestic product
GEF	Global Environment Facility
GIS	Geographic Information System
GNP	gross national product
GoB	Government of Botswana
GOS	gross operating surplus
HadCM3	Hadley Centre Climate Change Model
hh	household
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
HOORC	Harry Oppenheimer Okavango Research Centre
IGBP	International Geosphere-Biosphere Programme
IPCC	International Panel on Climate Change
IUCN	World Conservation Union
IUV	Indirect Use Value
LAI	leaf area index
LSU	large stock unit
NGO	non-governmental organisation
NMPSWW	National Master Plan for Sanitation and Wastewater
NPV	net present value
NRA	natural resource account
NWDC	North West District Council
OD	Okavango Delta
ODMP	Okavango Delta Management Plan
ORBMP	Okavango River Basin Management Plan
P	Pula
RALE	representative and accountable legal entity
ROW	rest of the world
SAM	Social Accounting Matrix
TLB	Tawana Land Board
UAW	unaccounted water
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WMA	Wildlife Management Area
WWTW	waste water treatment works

1 INTRODUCTION

1.1 Background

The Okavango river system flows from the Angolan high plateau through Namibia to form the Delta in Botswana. The river basin is the focus of a number of donor-funded initiatives aimed at ensuring development in the system is economically and ecologically efficient. The ERHIP Project, based in Namibia, the GEF/FAO project based in Angola and the USAID-funded ORBMP Project, based in Botswana, are all contributing to this in a basin-wide context.

Compared with many river basins, that of the Okavango is relatively pristine. However, along its length, demands on its water and other resources are expected to grow significantly in future. The impact of these demands will be felt mainly at the downstream end of the river system, in the Okavango Delta. The Delta's integrity and the important economic contribution it does and can make to Botswana's welfare will be threatened. On the 4th April 1997, Botswana became a contracting party of the international 'Ramsar Convention' and the Okavango Delta was listed as a wetland of international importance.

The Okavango Delta plays a key role in the economy of Botswana. A large inland Delta, the sink for the Okavango river, it supports an ecosystem which is relatively complex and rich in diversity compared to those on the surrounding land. It provides the focus for agro-pastoral land use, highly valuable tourism activities, fisheries, wildlife use, and natural plant use, which would not take place without it. As a natural asset it contributes to a very significant component national product. As an internationally renowned object of natural wonder it also generates significant non-use values in the global context.

In order to ensure the delta's conservation and wise use, the development of a management plan for the Okavango Delta is underway. This process is aimed at integration of resource management for the Okavango Delta that will ensure its long term conservation and that will provide benefits for the present and future well being of the people, through sustainable use of its natural resources (ODMP, 2002).

The strategy for implementation of the Okavango Delta Management Plan (ODMP) involves creating an improved sense of collective responsibility and accountability among communities and existing institutions with a mandate to manage the Delta and its resources.

The ODMP has identified twelve different components with their respective responsible institutions as crucial to this process and they are as follows:

- *Policy, planning and strategy including communication* is the responsibility of the Department of Environmental affairs (DEA);
- *Communication, dialogue and networking* by the DEA;
- *Hydrology and water resource management* by Department of Water Affairs (DWA);
- *Sustainable fisheries management* by the Division of Fisheries in the Department of Wildlife and National Parks (DWNP);
- *Wildlife management* by Department of Wildlife and National Parks (DWNP);
- *Sustainable tourism* by the Department of Tourism (DoT) in Maun and the North West District Council (NWDC) Economic Planning Unit (Tourism Section);
- *Waste management* by the NWDC Environmental Health Department (Waste Management Section);
- *Physical planning* by the Department of Town and Regional Planning (DTRP);
- *Sustainable livestock management* by the Department of Animal Health and Production (DAHP);
- *Vegetation resources* by the Department of Crop Production (DCP), Ministry of Agriculture and the Agricultural Resources Board (ARB) and Forestry Division, Ministry of Environment, Wildlife and Tourism;

- *Land use planning and land management* by Tawana Land Board (TLB) in association with the District Land Use Planning Unit (DLUPU); and
- *Research, data storage and data management* by the Harry Oppenheimer Okavango Research Centre (HOORC).

There is also active stakeholder participation in the main stages, an association of international stakeholders and an integrated planning process.

The policy, planning and strategy component of the ODMP is designed to provide the framework for implementation of the management plan; i.e. to integrate and guide sustainable management of the delta's resources. This component is vital in providing the inter-sectoral and cross-cutting linkages that can ensure consistency amongst the different components of the project, in the pursuit of sustainability principles.

The ODMP is trying to assess the fundamental linkages and interdependencies between the hydrological functioning of the Delta, its ecology and the economy these support. DWA is currently modelling the hydrological functioning of the Delta and from this work, planners should be able to determine how the water flows now, what the extent and shape of flooding is annually and how this might change under various scenarios, such as climate change, increased abstraction, channel blockage and clearance etc. Many of the other component parts of the ODMP are also collecting information on the ecology of the Delta and its economy, e.g. use of veld products, community based natural resources management (CBNRM), fisheries, tourism, etc.

The World Conservation Union (IUCN) is supporting the development of the ODMP, as part of the Water and Nature Initiative in Southern Africa. Part of the contribution of IUCN is to provide technical support to elements of the management plan development exercise, and in particular IUCN is targeted to provide support towards formulation of a vision, review of policy, and carrying out an economic valuation study of the Okavango Delta in conjunction with DEA.

1.2 Aims of the study

The economic valuation study is to inform management planning and practice, in the context of current and future activities being carried out under ODMP and other agencies, working towards conservation and sustainable management of the Delta's natural resources, and responding to the current and future threats to the Delta. These include unsustainable land use and resource exploitation, inadequate freshwater flows, habitat conversion and modification, invasive species, inequitable benefit sharing and lack of local economic incentives for conservation, unsupportive macroeconomic and sectoral policies, insufficient budget and financial support, and so on.

It is anticipated that the results of the economic study will assist the ODMP to:

- strengthen Botswana's negotiating position with Angola and Namibia regarding water allocation and river basin options,
- better compare development options (with consideration of environmental costs and values),
- document the different functions of the Delta (production, regulation, generation of information, cultural, etc),
- undertake lobbying purposes,
- re-evaluate hydrological data and fill in gaps in these data,
- determine the costs and benefits of aquatic weed control,
- determine the extent to which current and future generations depend on resources
- point to incentives to support sustainable management, especially community-level benefits
- determine the value of the use and or sale the Delta's plant resources,
- diversify CBNRM beyond wildlife-based tourism, and to identify resources and activities that have economic potential for CBNRM,
- assess the long-term sustainability of the Delta's tourism, in the context of global trends in tourism demand,
- assist in the resolution of conflicts (e.g., between tourism companies and communities),
- determine the degree to which the game reserve underpins tourism,

- inform economically efficient pricing of tourism royalties, concession/lease fees and other charges,
- determine the economic opportunity costs of choosing to use particular areas and resources in particular ways,
- determine and ameliorate sedimentation effects on Delta values,
- evaluate relationships between wildlife, photography, hunting in Delta

While this study will not carry out all the research required to answer the above questions, it will be able to provide much of the information required. A considerable volume of work has been done the past in various contexts to determine the economic value of goods and services associated with the Okavango Delta. Much of this work is recorded in the grey literature and a specific effort to locate and secure it will be part of this project. The ODMP economic valuation exercise will build on the data and literature already available.

The **overall objective** of this study is to determine the economic value of the environmental goods and services of the Okavango Delta in order to evaluate the implications of a number of management and resource allocation options for the area. The project will provide management recommendations that have a sound economic basis, which will help to ensure future sustainable use of the Okavango Delta.

The **terms of reference** for the study were as follows:

a. Conduct a thorough review of all the ecological and economic work that has been carried out in the Okavango Delta.

b. Determine what the GoB currently spends on management of natural resources in the Delta, e.g. control of invasive plants, wildlife management, compensation for loss of livestock due to predation etc.

c. In association with stakeholders, all other ODMP components and other relevant institutions, construct a conceptual model of the ecological-economic linkages in the Okavango Delta.

d. In association with stakeholders, all other ODMP components and other relevant institutions, describe the “goods and services” (e.g. fish, water purification) provided by the OD ecosystem and the “attributes” (e.g. biodiversity, scenic beauty) that contribute to its value.

e. In association with stakeholders, all other ODMP components and other relevant institutions, compile a comprehensive list of the types of values generated by all of these, following the Total Economic Value framework (i.e. Direct Use Values, Indirect Use Values, Option Values and Non-Use (Existence & Bequest) Values).

f. Working with the ODMP project secretariat and other component focal points, particularly the Department of Water Affairs and their consultants, develop and agree various scenarios for possible direct and indirect future natural and anthropogenic induced effects and management regimes, both within and upstream of the Delta.

g. Design detailed methodologies for valuation of the types of value described above in such a way as to make use of existing information, where possible, and inform management issues through valuation of the above scenarios. In determining valuation methods, account will be taken of the need to employ different types of methodologies appropriate to different levels of scale and stakeholders / socio-economic groups, e.g. the use of participatory methods at the local community level

h. Estimate the direct use values associated with use of ecosystem goods (e.g. resource harvesting) and enjoyment of ecosystem attributes (e.g. tourism) in terms of private (direct monetary) and wider economic (including subsistence and non-marketed) measures at current prices.

i. Estimate the indirect use values of the Okavango Delta in terms of private (direct monetary) and wider economic (including subsistence and non-marketed) value at current prices.

j. Describe the non-use value of the Okavango Delta as far as possible using available information.

k. Assess the potential changes to the values described above under different management scenarios.

l. Analyse the distribution of economic values and costs between different groups and sectors, at different levels, i.e. locally within villages, locally within the Delta, within the district, country, region etc and with season at present and under the different scenarios. Particular attention should be paid to poor households, female headed households and HIV/AIDS affected people.

m. Identify future needs for environmental economic information and studies (e.g. valuation of the environmental costs of existing and planned activities, such as tourism.

n. Provide "on-the-job training" to DEA staff in delivery of all activities by identifying appropriate staff in the DEA, involving them and working with them as part of the economic valuation team.

1.3 Limitations of the study

The study had to be carried out over a very short period, from December 2005 to July 2006, and with a very limited budget. Primary data collection was therefore highly restricted, both temporarily and in extent. Data collection concentrated on the value gained from the direct consumptive use of delta resources. Estimates of other types of value, including tourism value, had to be made on the basis of secondary information. Specific limitations of the different estimates are discussed in more detail under the relevant sections.

1.4 Structure of the report

Chapter 1 outlines the background, objectives and terms of reference of the study.

Chapter 2 provides a description of the study area and its socio-economic context.

Chapter 3 describes the valuation framework and the approach and methods used in the study.

Chapters 4, 5, 6 and 7 describe the different types of values of the Okavango Delta, as well as the detailed methods used to estimate these. Chapters 4 and 5 describe the direct use value of the delta, divided into tourism and household use of delta resources. Chapter 6 provides estimates of the indirect use value of the delta, and chapter 7 very briefly considers the non-use value of the delta, but does not provide a value estimate.

Chapter 8 provides a synthesis of the above values, estimates their impact on the national economy, and describes the value of the delta as a national asset.

Chapter 9 evaluates a suite of potential scenarios describing the future management of the delta, and provides a rough estimation of the way in which these values would be affected.

Chapter 10 provides the conclusion and recommendations based on the overall findings of the study.

2 STUDY AREA

2.1 Location and extent

The Okavango Delta is situated at the northern most edge of the Kalahari sandveld in north western Botswana, below the Caprivi Strip in Namibia. It is the largest inland delta in the world, and contains 95% of Botswana's surface water. The delta and surrounding area are included in the Okavango Delta Ramsar Site. The ODMP is concerned with the entire Ramsar Site.

The entire Ramsar site covers a total of 55 599 km^2 (Figure 2-1). The spatial extent of the delta itself is differently defined. Scudder *et al*. (1993) define the delta as an area of 16 000 km^2; the ODMP considers the extent of the delta as almost 28 782 km^2. Note that the ODMP study area also includes some of the wetland area associated with the Chobe-Linyanti system in the north east of the area. However, the Delta dominates the wetland area and is the main focus of this study.

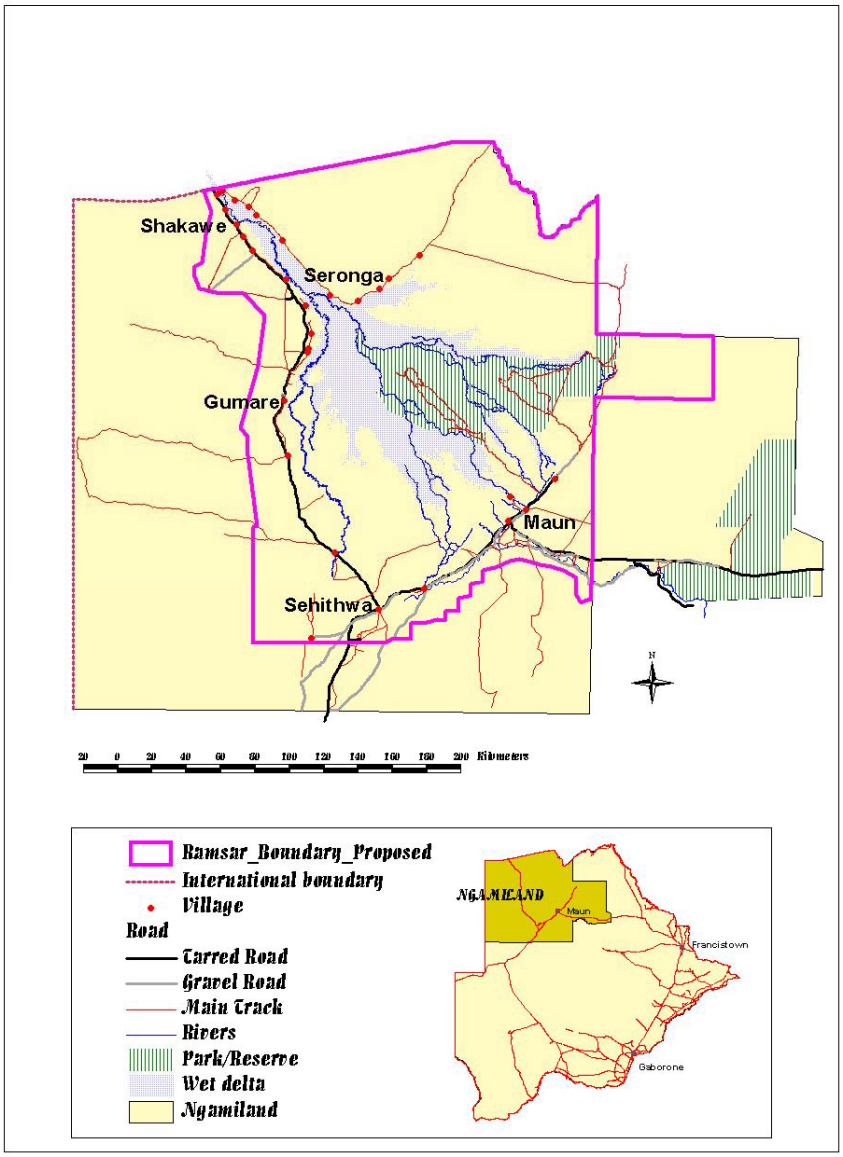

Figure 2-1. Boundary of the Okavango Delta Ramsar site

The Ramsar site lies entirely within Ngamiland District (Figure 2-1), one of the ten districts of Botswana, and covers more than half of the area of the district.

While the valuation study considers natural resources throughout the Ramsar site, the primary focus is on the wetland itself, within the context of the broader study area (the Ramsar Site). Most of the population that is directly affected by the wetland is within the Ramsar site.

2.2 The physical environment

2.2.1 Topography

The study area is a vast, very gently undulating plain. The only topographic feature which stands out is the slightly elevated Ghanzi ridge which contains the Tsodilo Hills, in the extreme west of the study area.

2.2.2 Climate

The Okavango Delta is located in a semi-arid region which has hot, wet summers and cold, dry winters. The climate varies from being humid in the north, with a significant orographic effect, to semi arid in the south (TLB 2006). Rainfall occurs mainly in November to March, with an average of 500mm per annum. Evaporation is 5 – 6 times higher than rainfall, and accounts for 95% of the annual loss of surface water from the delta Ellery & McCarthy 1994, in TLB 2006). The majority of rainfall tends to fall over a few days, and thus rainfall is sporadic, and there is a high risk of drought conditions (Bhalotra 1987 in TLB 2006). Despite the nature of the rainfall, soil erosion is not a major problem because of the flat topography.

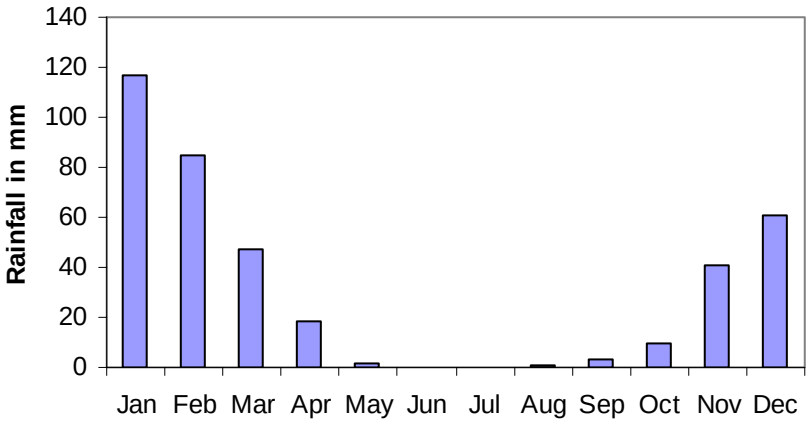

Figure 2-2 Mean monthly rainfall in Maun for the period 1990 to 2004

2.2.3 Drainage

The Okavango Delta is the main physiographic feature in the project area. From where it enters Botswana, the Okavango River flows in a south easterly direction for just over 100 km before fanning out into the delta proper. This section of river is known as the Panhandle. After travelling down the panhandle the water is then distributed over three primary channels (Thaoge, Jao-Boro and

Maunachira-Khwai) and thence into numerous smaller channels and floodplain areas. Only a small portion of the inflow leaves the delta (on average 3% of the inflow; Jacobsen *et al*, 2005).

The delta is drained by the seasonal Thamalakane River which flows in a south westerly direction from the north-east, and passes through the town of Maun. This river occasionally flows as far as Lake Ngami, and into the Boteti River. There is also some outflow from the delta into the Selinda Spillway and the Linyanti swamps (TLB 2006).

Other major ephemeral rivers in the delta include the Nhabe and Kunyere Rivers. The Thaoge River once drained the western edge of the delta into Lake Ngami, but has not flowed from a number of years and is thought to be drying up permanently.

The delta consists of three major ecotypes: permanent swamp (channels and lagoons), seasonally inundated areas, and drier, higher land masses (Tawana Land Board, TLB 2006). The latter are savanna habitats commonly known as the "sandveld tongues", and are found in the southern and eastern delta. In addition, Chief's Island is a large arid island in the middle of the delta. These are focal areas for tourism because of their wildlife, scenery and accessibility.

According to Scudder *et al*, the delta is divided into several categories of 'swamp' (Table 2-1).

Table 2-1: Different land categories of the Okavango Delta area based on Scudder et al. 1993

	Size of area in km^2	**Percentage of delta**
Perennial swamp	4 887	30.8
Seasonal swamp	3 855	24.3
Seasonal grassland	2 760	17.4
Intermittent flooding	2 502	15.8
Drylands	1 842	11.6
Total	**15 846**	**100**

Note: The ODMP hydrological model covers a study area of 27 978 km^2.

The delta defined by ODMP is much bigger, mostly through the incorporation of more dryland or rarely flooded areas (over 19 000 km^2 compared to less than 2 000 km^2 dryland in Scudder *et al*., 1993). The following categories are distinguished in the hydrological model, and are used in this study in the estimate of the indirect use value.

Table 2-2: Different land categories of the Okavango Delta based on Jacobson et al. 2005

	Land category	**Area (km^2)**
5	Water-pan handle	1,446
4	Normally flooded area	2,152
3	Seasonally flooded	2,328
2	Occ. Flooded	3,534
1	Rarely flooded	19,322
	Total delta	**28,782**

Note: EAR means estimated annual recharge.

2.2.4 Hydrology

The pattern of flooding is roughly inverse to the pattern of rainfall. Rain falls in the catchment areas some 600km away during summer, and reaches the top of the panhandle in about April. Some 9.4 cubic kilometres per year reaches the delta on average, although this fluctuates widely from year to year, depending on rainfall in the Angolan catchment area (Mendelsohn & el Obeid 2004). The floodwaters then encounter tremendous resistance as they enter the papyrus swamps of the

panhandle and then fan out into the distributaries and floodplains of the delta. The waters thus take several months to reach the distal portions of the delta, finally reaching Maun only in the late dry season (August-October; Mendelsohn & el Obeid 2004, Wolski *et al*. 2005). As the floodwaters arrive, the delta expands from about 5000 km^2 to between 6000 and 12000km^2 in extent during flooding, depending on the size of the flood (Wolski *et al*. 2005). Very little contribution is made by local rainfall, but in extremely high rainfall years (>800 mm per annum) rain-induced floods can occur (Wolski *et al*. 2005).

Because of its location in semi-arid north-western Botswana, evaporation is about 2100 mm per annum, and amounts to far more than the average rainfall of 300 – 500 mm per annum. Most of the water flowing into the delta is thus lost to evaporation or evapotranspiration, with a very small proportion moving into groundwater aquifers (Jacobsen *et al*. 2005).

The hydrological model (Jacobsen *et al*, 2005) showed that most available water evaporates from the delta. The discharge out of the system is minimal and consequently changes in inflows are mostly absorbed by changes in subsurface water and groundwater recharge. The Boteti River and Lake Ngami appear to be drying up, even though the latter briefly held some water in 2004/05. Current groundwater abstractions do not affect the flood patterns, but may locally cause groundwater mining (DWA, 2005). The average outflow is around 296 Mm^3 per annum (Scudder *et al*, 1993). Evapotranspiration is as high as 2 169 mm per annum, but its spatial variation is significant.

Wilson and Dinger (1976) estimated a water balance of 16 billion m^3 or Bm^3 as follows:

Inflow	+	Precipitation	=	Evapotranspiration	+	Outflow	+	Groundwater outflow
11 Bm^3	+	5 Bm^3	=	15.4 Bm^3	+	0.3 Bm^3	+	0.3 Bm^3.

The ODMP hydrological and water resource model (Jacobsen *et al.*, 2005) estimates the following water balance (in mm/ annum):

Inflow	+	Rainfall	=	Evapotranspiration	+	Outflow	+	Sub surface storage change
324	+	380	=	-762	+	2		-58 (water balance error of 2).

A more recent ODMP model, based on results for 1987 to 2002, generates the following balance (Alisdair Macdonald, ODMP, *in litt*.):

Inflow	+	Rainfall	=	Evapotranspiration	+	Outflow	+	Surface change	+	Sub surface change
282	+	447	=	717	+	5	+	5	+	2.

These balances confirm that evapotranspiration is substantial and outflow small.

The spatial distribution of water within the delta is also important for its value. The spatial distribution is highly dynamic, and currently the western side of the delta tends to become drier, reducing its diversity and use value, while the eastern side receives more water. Cyclical patterns appear to exist and tectonic movement influences water distribution.

The amount of flooding has been decreasing over time, possibly due to increased evaporation, declining rainfall in the Angolan highlands or locally, or increased infiltration due to tectonic activity (Hutchins *et al*. 1976, in TLB 2006).

2.2.5 Soils

The soils of the delta itself are dominated by arenosols, and reflect the organic and sandy sediment load for the Okavango (Thomas & Shaw 1991, SMEC 1987, in TLB 2006). Around the delta, the dryland soils are mostly Kalahari sands. There is no agricultural potential in the Ramsar site (TLB 2006).

2.2.6 Vegetation

The Okavango Delta comprises a mosaic of perennial swamps, seasonally flooded open grasslands, woodlands and palm-fringed islands with forests. Water flowing down the panhandle still carries a good nutrient load. Lush forests line the river banks in the upper reaches, and the mid to lower reaches of the panhandle are dominated by papyrus *Cyperus papyrus* and *Phragmites* reeds. Below the panhandle, the perennial swamps are dominated by Papyrus and the *Phoenix* palm. The distribution of palms, which are slower to respond to change than papyrus, reflects the greater extent of the delta in the past, e.g. along the Thaoge River. By the time the waters fan out into the main delta, they are depleted of much of their nutrient and sediment loads, and the system is largely oligotrophic. Towards the south there is more seasonally-flooded habitat is characterised by wide grassy floodplains which border deciduous Kalahari woodlands. Islands within the delta area contain dryland areas that are a combination of grasslands, forests, woodland and palms, as well as riparian trees.

The delta is surrounded by mopane woodlands to the north east, dominated by the mopane *Colophospermun mopane*, and acacia woodlands to the south west, which are characterised by *Acacia erioloba* and *A. tortilis* (Mendelsohn & el Obeid 2004).

2.2.7 Fish and wildlife

The Okavango Delta is a 'low nutrient/ productivity system, with small local patches of higher production, and with good diversity of macro and micro invertebrates but no strong evidence of endemism (i.e. species unique to the delta area)' (Scudder *et al*, 1993, p. 51). Within the Ramsar Site, fish and wildlife are concentrated in the Okavango Delta.

Over 80 species of fish occur in the Okavango basin, but species diversity is generally fairly low in any particular area, in the region of 15 to 30 species, and fish numbers tend to be dominated by just a handful of species (Mendelsohn & el Obeid 2004). In general, the density of fish is highest in the panhandle, decreasing towards the outer edges of the delta, which are poor in nutrients and hence food supply. The fish fauna is dominated by bream (*Oreochromis andersoni, O. Macrochir, Tilapia rendalli, Serramnochromis* spp), catfish *Clarias* spp, and tiger fish *Hydrocynus vittatus* (Mosepele 2005). The floodplains and seasonal swamps are particulary valuable as fish breeding habitat. These areas provide fish larvae with a food-rich refuge during the flood season. Flooding is thus the main driving force for fish breeding in the delta. Young fish return to the permanent waters as the floodwaters recede, but many fish are trapped in pools during this period, providing an important food resource for both people and animals (Mendelsohn & el Obeid 2004).

The delta supports a high biomass of large herbivores, mainly due to the high numbers of elephant and buffalo which account for 73% of this (Bonyongo 2004 in TLB 2006). The largest wildlife populations are found in Moremi Game Reserve, which contains some 2000 large mammals (Mendelsohn & el Obeid 2004) and the adjacent CHAs. Lechwe are the most abundant large mammals in the delta, with total numbers of about 50 – 60 000. Their numbers are sensitive to the degree of flooding (Mendelsohn & el Obeid 2004). Some 20 – 30 000 eleohants spend the dry season in the delta, their numbers having increased rapidly in recent years. In addition, the delta supports about 5000 Tsessebe, 30 – 40 000 buffalo, 5 – 7000 giraffe, 20 000 impala, sitatunga, small numbers of reedbuck, several hundred waterbuck and thousands of hippopotamus. All large mammals except elephants are restricted in distribution by the veterinary fences which keep them enclosed in the delta. Certain species such as lechwe, sitatunga, waterbuck, hippo and crocodile are largely confined to the

permanently wet areas of the delta. Elephants are water-dependent but range widely throughout the area, resulting in human-elephant conflicts.

Over 500 species of birds have been recorded in the delta (Mendelsohn & el Obeid 2004), including rare and endangered species such as Wattled Cranes and Pels' Fishing Owl. The densities of birds are relatively low, however, reflecting the low nutrient status and productivity in this ecosystem.

2.3 Land use and tenure

Land in Botswana is under three types of tenure, with Tribal Land making up 71%, State Land covering 23% and Freehold Land making up 6% of all land in the country. Within the Okavango Delta Ramsar Site, all but 4.6% of land is under Tribal Land tenure, the remainder being State Land. There is no Freehold Land in this area. Tribal Land is held in trust for communities by the Land Boards which are responsible for land administration. Usage rights are granted to Botswana citizens either communally or to individuals, usually for residential purposes, ploughing or boreholes. These rights are typically passed on through generations. In addition, citizens and non-citizens can acquire 50-year leases for commercial and industrial developments. Land cannot be sold, but the improvements or developments can.

Ngamiland District is divided into 52 Controlled Hunting Areas (CHAs) under the Wildlife Conservation and National Parks Act, 1992. A total of 37 of these are within the Ramsar Site. Based on their natural resource characteristics, CHAs are zoned, mainly as:

- livestock areas;
- wildlife management areas (WMAs); and
- multi-purpose (pastoral/arable/residential) CHAs.

Thus the CHAs correspond to the Game Reserve and WMA boundaries, and also divide up the multi-purpose communal areas into blocks for purposes of setting hunting quotas. It is important to note that the boundaries of these CHAs are not well known at ground level.

About half of the study area is under wildlife utilisation, with 9.4% being within protected areas (Moremi Game Reserve) and 41.8% being designated as Wildlife Management Areas (WMAs). Moremi Game Reserve is administered by the Department of Wildlife and National Parks (DWNP). WMAs are areas that surround protected areas and serve as buffer zones and migratory corridors. Whereas there is total preservation and protection of wildlife resources within protected areas, sustainable utilisation of wildlife resources is encouraged in WMAs, and they provide the opportunity for establishment of Community Based Natural Resource Management (CBNRM) systems. WMAs can be designated as:

1. Commercial Wildlife Utilsation;
2. Community Wildlife Utilsation;
3. Commercial Photographic area; or
4. Community Photographic area.

The community WMAs are managed by community trusts, while the commercial WMAs are leased by companies.

The remaining 48.8% of the study area is communal land area which includes settlements, arable lands and grazing lands. Pastoral lands are dominant, and arable agriculture is mainly for subsistence. A total of about 48 900 ha are cultivated in the study area, of which about 10 000 ha are planted per year on average. Some 75% of this is for dryland farming, and 25% is for flood-recession farming, known as 'molapo farming' (Bendsen 2003, in TLB 2006). Cattle are kept around the village areas and also at cattle posts many of which are quite far from the villages and the delta. This is made possible by use of boreholes for water supply. However, the traditional separation of village area, agricultural lands and cattle posts is becoming increasingly blurred. The distribution of cattle is limited by a cordon fence in order to limit contact between wildlife and cattle, with most of the wetland area being a cattle free zone. The main veterinary fences are the southern and northern Buffalo fences which cross the study area.

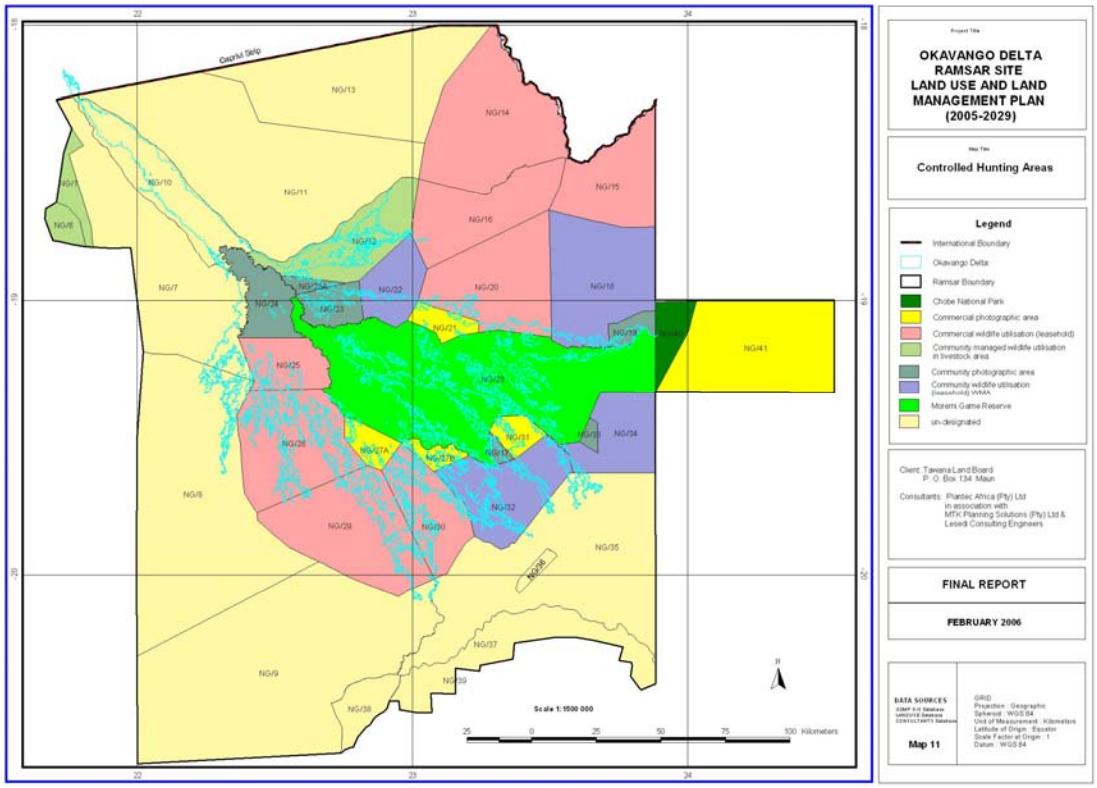

Figure 2-3 Land use categories for each of the Controlled Hunting Areas within the study area. Note: NG41 should be designated as Community wildlife utilisation (blue).

2.4 Population and settlements

The study area was originally populated by the San, but various tribes have moved into the area in the last 300 years, creating a high ethnic diversity. The Bayei and the Hambukushu moved into the area while fleeing the Balozi expansion further north. The Bayei, who are primarily fisher - farmers, introduced dugout canoes (mokoro) to the delta (TLB 2006). The Hambukushu are primarily fishers, and less involved in agriculture. The Batawana, mainly livestock and dryland farmers, later expanded into the area, and became dominant in the administration of the district. The Baherero settled in the southwestern part of the study area at the turn of the last century, fleeing the Herero-German war. They are primarily pastoralists, hardly growing crops at all. More recently, refugees of the Namibian liberation war and Angolan civil war have resulted in the establishment of communities in the area (the Etsha settlements). These people have introduced basket-making skills to the area (Terry 1984, 1986).

The population of the study area is concentrated around the edge of the delta and along the main roads. There are a few small settlements within the delta. Most settlements are concentrated around the Panhandle. Half of the population is located in Maun. Of the approximately 67 settlements in the Ramsar Site, 54 have populations of less than 1000, and 11 of 1000 – 5000. There has also been a proliferation of ungazetted settlements (TLB 2006).

The total population of the study area in 2001 was estimated to be about 110 852 people in 18 277 households (TLB 2006). Growth rates over the last decade were about 4.1% per annum, compared with 3.4% over the previous decade. Children (0 – 19 years) make up 53% of the population. A total of 56 959 people (53% of the population) are of working age (15 – 64 years). Older people only make

up 6% of the population. Life expectancy is dropping, as a result of HIV/AIDS and other factors. More than half (55%) of households are female-headed.

The tourism industry is the major employer of labour, with men being employed as polers, drivers, guides, camp builders and security guards, and women employed as maids, receptionists and in catering, cleaning and laundry (TLB 2006). Some villages (e.g. Ditshipi, Daonara, Seronga) have become centres for mekoro-based tourism.

Most people living in the study area are rural and poor. Most households have a diversified production system which is aimed at reducing risks in an unstable environment. The importance of different acgvities varies between households and communitie, and between seasons and years, in response to variations in rainfall, flooding, access to reouces, labour and capital and other factors (Scudder *et al*. 1993). The main actiies are dryland and flood recession agriculture, livestock, wage labour, a range of commercial actiivies, fishing, gathering and hunting (Scudder *et al*. 1993). Cattle keeping may not benefit more than 20% of the population (Campbell 1976), but is preferred by most households, who value cattle not only in terms of production but for other reasons including a means of saving and investment (Scudder *et al*. 1993).

2.5 Zonation used in this study

For the purposes of this study, the study area was divided into zones based on consideration of settlement patterns, land use and natural resource characteristics. Five zones were recognised as follows (Figure 2-4):

1: Panhandle
This zone is characterised by the lack of floodplain area, the high numbers of settlements along the river, and the relatively high density and accessibility of fish and aquatic plant resources. There is little opportunity for recession agriculture (molapo farming).

2. West
This zone lies to the west of the delta proper, and people living here have access to wetland and floodplain resources, including molapo farming areas.

3. South West
The zone is relatively arid and sparsely populated. Its settlements follow what was formerly the outer margins of the delta, but these are now far from the wetland and floodplain areas.

4. South East
This area is dominated by Maun and is relatively far from the main wetland areas, but does have reasonable access to some of the distributaries and floodplain areas.

5. Central
This zone is largely delineated on the basis of the buffalo fence and has wildlife as the main land use. This zone encompasses most of the wetland area, and there is very little upland area. While dominated by the Okavango Delta, it also includes the Linyanti-Chobe wetland areas on the northeastern border of the study area. There are very few people living in this zone, in a few scattered villages as well as in association with some of the larger tourist lodges.

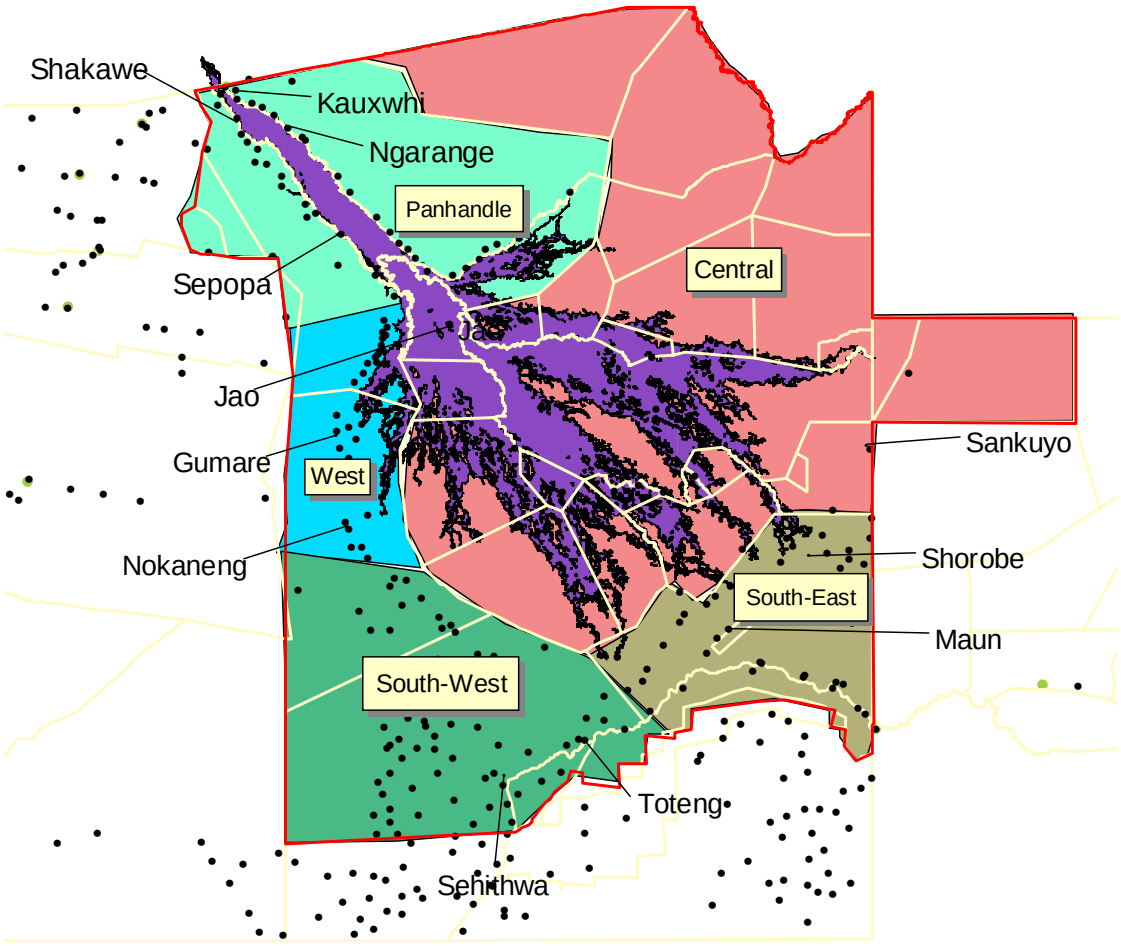

Figure 2-4 Zonation of the study area for this study

2.6 Demographic and socio-economic characteristics of the zones

Based on GIS population data (note slight discrepancy in total from that reported above), about half of the population of is concentrated in the South East zone, where Maun is located (Table 2-3). The Panhandle contains about a quarter of the population. Very few people actually live in the Central zone (Table 2-3).

Table 2-3 Population of the zones

Zone	Population 2001	Household size (this study)	Estimated number of households
Panhandle	25483	7.2	3,531
West	17,108	8.3	2,056
South West	9,193	7.5	1,226
South East	53,497	8.3	6,412
Central	1,475	7.3	202
Total	106,756		13,427

Ethnic composition differs markedly between the five zones. Based on the sample from this study, the Panhandle is dominated by the Bahambakushu, the South West is dominated by Batawana and

characterised by a high proportion of Baherero, and the remaining zones (West, Central and South East) are dominated by Bayeyi (Figure 2-5).

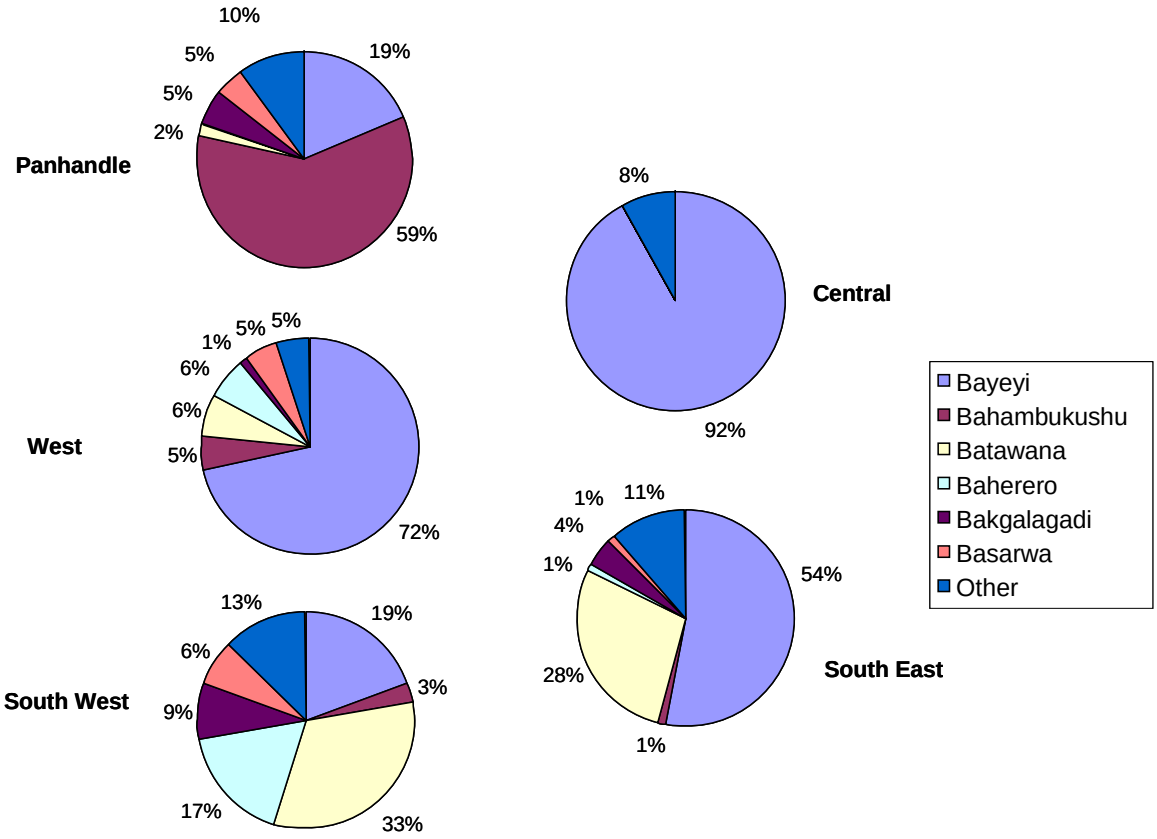

Figure 2-5 Ethnic composition of households sampled in the five zones

About a quarter of adults in the study area are employed, with rates of employment being highest in the Central and South-East zones (Table 2-4). Tourism and wildlife are the main employers in the Central zone, are also very important in the South East Zone and are significant in the Panhandle. Government is the main employer overall, and is particularly important in the West and South West Zones.

Table 2-4 Percentage of adults that are employed, and the percentage of jobs in different sectors, for households sampled in each of the zones

Zone	Pan-handle	West	South West	South East	Central	Overall
% adults employed	24%	21%	19%	29%	32%	25%
% jobs in:						
Tourism	4%	0%	1%	15%	51%	13%
DWNP	4%	0%	0%	2%	5%	2%
Other Gov	41%	56%	64%	41%	15%	45%
Farming	15%	12%	1%	1%	0%	6%
Fishing	3%	0%	0%	0%	0%	1%
Trade in natural resources	7%	1%	0%	0%	0%	2%
Trade in agric. products	3%	2%	1%	0%	1%	1%
Other	23%	27%	30%	37%	22%	30%

3 VALUATION FRAMEWORK AND METHODOLOGY

3.1 Overall approach

The study builds on considerable work that has been carried out in the study area, as well as primary data collection using surveys. The study began with an initial review of existing published and unpublished information and a week-long reconnaissance which included site visits and a fly-over of the entire delta and panhandle, meetings with stakeholders and researchers, and team discussions on the ecological-economics linkages and values pertaining to the study. This was followed by detailed methodological design. An extensive interview survey was conducted of households throughout the study area and various key informant interviews were held to inform different aspects of the study. Values were related to the biophysical characteristics and functioning of the delta as far as possible. The conceptual understanding gained was then used to estimate the implications of alternative management scenarios relating to water allocation and land-use issues. The study was also geared to evaluating the level of dependence of different types of activities on ecosystem functioning and conservation action, and to evaluate further economic potential of the area.

3.2 Valuation framework

3.2.1 Total Economic Value framework

The economic value of the Okavango Delta was studied within the framework of Total Economic Value, which includes direct use, indirect use and non-use values. These values were considered at various scales from local (e.g. contributions to livelihoods) to national or regional (e.g. effects on national economic growth and employment), as appropriate. The use values were estimated in a way that ensured compatibility of the results with the Directorate of Environmental Affairs' natural resource accounting system, and the national economic accounting system.

The total economic value generated by the Okavango Delta can be categorised into different types of value (Figure 3-1), providing a useful framework for analysis.

Direct use values result from economic activity and are generated through the consumptive or non-consumptive use of the delta's natural resources. In the delta, direct use values are generated through crop production, livestock grazing, fishing, wild plant use and hunting. They are also generated through consumptive (hunting) and non-consumptive (wildlife viewing) tourism. Rather than separating consumptive and non-consumptive value, as conventionally done within the Total Economic Value framework, we separate household use (largely consumptive) and tourism use (both consumptive and non-consumptive), for ease of analysis.

Indirect use values are values generated by outputs from the Okavango delta system 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 functions, such as water filtration, flood attenuation, and carbon sequestration. They also include benefits (or costs) arising from the provision of source areas for wild animal populations.

Non-use values include the value of having the option to use the resources and generate use values from the Delta in the future (option value), as well as the value of simply knowing that the resources within the wetland are protected (existence value including specific elements such as cultural, aesthetic, biodiversity and bequest values). Although far less tangible than the use values, non-use values are reflected in society's willingness to pay to conserve these resources, and with appropriate market mechanisms, can be captured through transfers and converted to income. Non-use values are measured using survey-based methods, and was beyond the scope of this study.

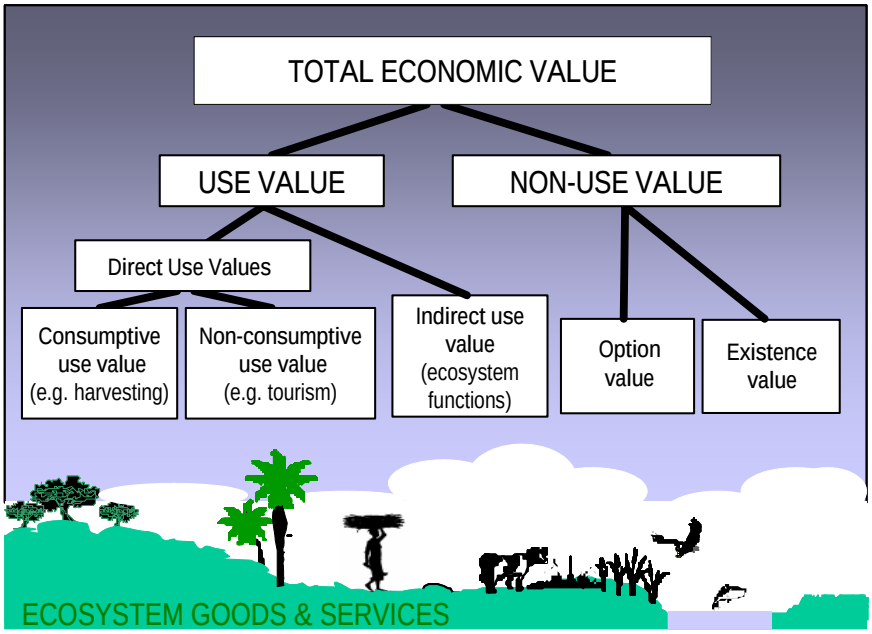

Figure 3-1. The classification of ecosystem values that make up Total Economic Value (Turpie et al. 1999).

Direct and indirect use values are of particular importance in the developing country context of Botswana, for which a critical national objective is to create growth in income and employment. These values are manifested directly or indirectly in tangible income and employment. Existence values inherently are not manifested in income and employment, and they are often highest in foreign countries. Nevertheless, global existence values can be high and the resultant willingness-to-pay can be captured globally and converted to income within Botswana, for example through grants.

3.2.2 National accounting framework

While the Total Economic Value framework defines the types of values to be quantified, the national accounting framework defines the way in which the value is expressed. Values, as defined above, could be measured at a local, regional or national level, and from a private (financial) or a social (economic) perspective. National Accounts quantify the value of production at a national scale and measure the total output in the economy and how this changes over time or under different policies. It provides the information on the value of production from the perspective of Botswanan society as a whole.

In a National Accounting framework, direct and indirect values carry a different meaning from that described under the Total Economic Value framework. The direct values generated from production, through direct or indirect use of an ecosystem, are the turnover and net income generated. However, these values are only part of the total macro-economic impact of the delta. For example, through crop production or the provision of tourism services, demand is generated for inputs in the rest of the economy. Thus, in order to provide accommodation services to tourists, hotels and lodges must purchase goods and services used as inputs to production, such as food, textiles, petroleum products, thatch for roofing, telecommunications services, etc. Industries supplying these goods and services must, in turn, employ workers and purchase inputs to produce their goods and services. In addition, when people are employed and earn wages, those wages are used to purchase consumption goods, which must be produced, requiring additional employment and generating more income. This indirect effect is sometimes referred to as the “backward linkage” or “upstream linkage” in the supply chain. Thus, even though tourism enterprises may operate in remote areas, they have an impact throughout the entire economy. Similarly, agriculture and other natural-resource-based activities also have upstream linkages.

The *total* economy-wide impact of the Okavango Delta is a sum of the direct plus the indirect impacts (Figure 3-2). The ratio of the total to direct impact (on sectoral output, incomes, employment or any other variable relevant for policy) is called a "multiplier" because it measures how a change (increase or decrease) in one sector's level of activity will affect the entire economy.

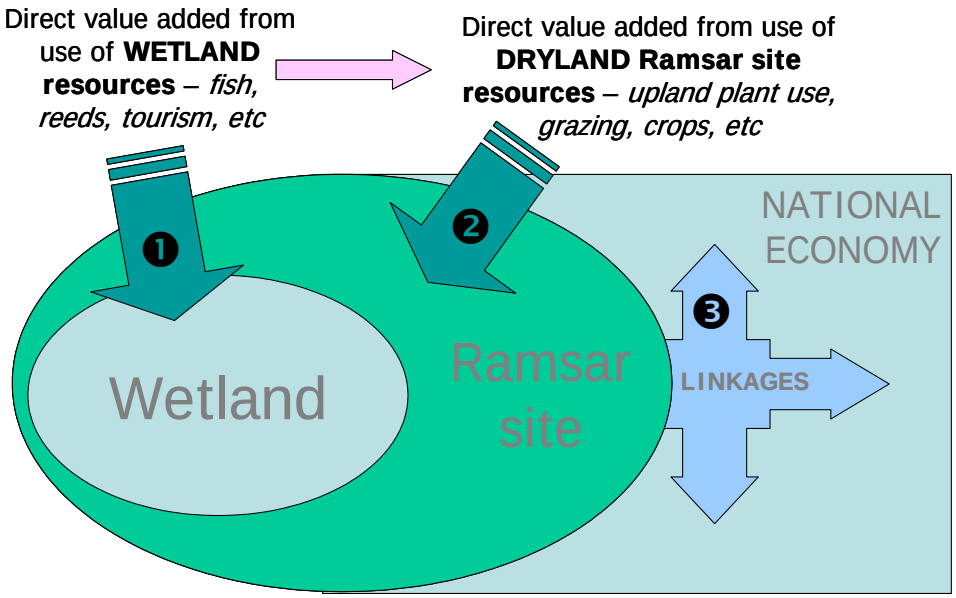

Figure 3-2. Direct use values and their impact on the economy

3.3 Valuation methods

3.3.1 Direct use value: Tourism

No primary data could be collected during this study, and thus estimation of the tourism value of the delta relied entirely on existing information.

Names of tourism enterprises located in the study area were obtained from the Ministry of Tourism. Details on bed numbers and prices for as many of these enterprises as possible were obtained from brochures and from the internet.

Three methods were used to estimate turnover in the industry attributable to the delta, as follows, and the average value was used. The first two were based on the estimated relative size of each enterprise, and the third was based on estimated occupancy rates.

Three types of enterprise models were used in this study: a typical ecotourism lodge, a safari hunting enterprise, and a community-based natural resource management (CBNRM) model.

1. The ecotourism lodge model (Appendix 3) is for a typical up-market lodge, and is based on the model developed in Barnes *et al* (2001) with corroboration models developed in FGU-Kronberg (1988a) and Barnes (1998) with updated values gleaned from tourism operators, particularly Wilderness Safaris, pers. comm. (2006), as well as from the internet.
2. The safari hunting model (Appendix 4) is based on earlier ones of FGU-Kronberg (1988a) and Barnes (1998), Unpublished Data, Economics Unit, Ministry of Environment and Tourism, Windhoek, Namibia (2006), and updated with values from ULG Northumbrian (2001).
3. Barnes' (2001) CBNRM model and two Caprivi Conservancy models were used to calculate 'other CBNRM income'.

Turnover was estimated as follows:

1. Method 1: Each of the tourism enterprises was allocated a size factor as an estimate of the level of turnover relative to the typical model.
2. Method 2: As above, except that the size factor was estimated by members of one of the larger tourism companies (Dave van Smeerdijk and colleagues at Wilderness Safaris).
3. Method 3: Data were gathered on the number of beds, and the average prices of as many of the enterprises as possible. Average values were interpolated for budget camps, luxury camps, guesthouses and hunting camps. Occupancy rates were assumed to be 40% for hotels and budget camps, 35% for hunting camps, and 50 – 85% for luxury camps.

A portion of this turnover was then attributed to the delta. For hotels, this was assumed to be 25%, for guesthouses, 60% and for camps, 100%. About 50% of turnover by mobile tour operators was assumed to be attributed to the delta. Turnover values were divided into non-consumptive tourism, safari hunting tourism, and CBNRM. Total CBNRM turnover includes that of the lodges, camps in those areas, as well as that of community trusts (listed as 'Other CBNRM' income).

Turnover in related sectors was estimated using ratios from a previous study of tourism in the area (Barnes *et al*. 1988 – FGU report). These ratios describe turnover of other items relative to camp turnover (Table 3-1).

Direct value added was calculated based on the turnover to direct value added ratios in the enterprise models.

Table 3-1 Estimated ratio of turnover of different tourism enterprises relative to safari lodges, based on a 1988 study of 70 financial statements in the tourism industry (Barnes *et al*. 1988)

Type of enterprise	Ratio of turnover relative to safari lodges
Safari lodges	1.00
Mobile safaris	0.10
Tourist motels	0.66
Hotels	4.08
Safari hunting	0.84
Travel agents	2.48
Air charter	1.69
Restaurants	1.29
Bars/bottle stores	1.15
Airlines	12.10

3.3.2 Direct use value: Household use of resources

Direct use values were estimated using social survey methods in conjunction with existing information in the published and unpublished literature, and in existing economic models. Questionnaire instruments were prepared in advance and refined during the planning meeting of February 2006. After the survey instruments were designed, team members then travelled to Shakawe to undertake a series of focus group meetings in Area 1 at Shakawe on the 20th of February 2006. Ten enumerators were trained over a period of 2.5 days (21 – 24th February 2006) to carry out the survey. After training, eight were selected to carry out surveys and a ninth was engaged to translate the questionnaire from English to Setswana and to also assist with translation in focus group meetings. The questionnaires were tested in Maun and then refined before data collection commenced. The focus groups and household surveys were undertaken from 26 February to the 8th of March 2006 under the supervision of two of the study team members. The itinerary for the focus group and household surveys is attached as Appendix 1.

Information on household activities and use of natural resources was collected in three different ways:

3.3.2.1 Focus group discussions and key informant interviews

Focus group discussions were held to collect information of a generally applicable nature, e.g. on seasonality, markets and prices, as well as to collect sufficient information to be able to make a preliminary quantitative estimates of natural resources harvesting and processing and associated economic values. Focus group discussions were held on several topics in each village, as applicable:

- (Men) Fishing
- (Men) Wood products, hunting and honey
- (Women) Medicinal and wild food plants and fuelwood.
- (Men and women) Reeds, sedges, grasses, palms, clay and associated production

Each group consisted of 5 to 6 people involved in the relevant activities. Discussions followed a questionnaire, but could deviate from this, or concentrate on a particular aspect, as appropriate. The basic structure of focus group discussions is outlined in Box 1. In addition to, and sometimes instead of, formal focus group discussions, informal discussions were held with members of the village on a variety of activities.

Box 1. General structure of Focus Group discussions

FOCUS GROUP DISCUSSIONS

A. Introductions
The purpose of the discussion was explained, and members of the group were encouraged to be as open as possible about the issues to be discussed.

B. Resource description
All species of natural resources were named and described in detail, giving where they occur or are grown. Their treatment and uses were also described.

C. Rules of access
The group was asked to describe how households gain access to resources, and any limitations on use.

D. Who is involved
People were asked about the role of men, women and children in the production or harvest of the resource.

E. Equipment
The group was asked about the type of equipment used, its price, durability, and whether it is shared among households.

F. Seasonality
The group was usually first asked to describe seasonality in the availability and harvesting of certain resources. Some groups were also asked about seasonality of different agricultural activities (e.g. cultivating, harvesting).

G. Returns to effort
The group was asked how much could be harvested in a day or week during different times of year.

H. Prices and inputs
Selling prices were obtained for each resource and for products made from these resources. Natural resource inputs into crafts and other products were also quantified.

I. Changes in availability
Members of the group were asked to describe and explain changes in availability over time.

3.3.2.2 Household questionnaires

Quantitative data on natural resource use was obtained by means of an intensive household survey during March 2006. Household surveys were carried out in five zones. The household questionnaire served to quantify the use of natural resources, and get quantitative info on agriculture, value added through processing, and other income generation. The main topics covered in the questionnaire are described in Box 2 below. The most difficult questions were posed early in the questionnaire, with agricultural production at the end, to counter the effects of survey fatigue. Questionnaires took just under an hour to complete (49 ± 66 minutes).

Box 2. General structure of the household surveys

HOUSEHOLD SURVEYS

A. Household information.
Household location
Household size and composition, education, occupations
Awareness of the proposed sugar scheme, etc (results reported in the sociology study)

B. Relative value of household production
Respondents asked to apportion a pile of stones among eight different sources of income (crops, livestock, woodland resources, floodplain grassland resources, fish, other wetland resources, other cash income from jobs, trade etc., and pensions) to indicate their relative contribution to household income in an average year.
Cash income: from wages, pensions, and absent family members

C. Use of natural resources
Respondents were asked about fishing, wood products, honey, hunting, clay, reeds, papyrus, grasses, palms, food and medicinal plants. For each resource they are asked about the following, as applicable:

- Whether they harvest the resource, and in the case of fishing, household fishing effort and equipment
- amount harvested over the past year,
- amount sold and price per unit
- amount of products produced from natural resources
- amount sold and prices obtained,

D. Crops

- access to fields, total area cultivated, and which crops grown
- amount produced in the last year for each crop

D. Livestock

- numbers of small and large stock
- production over the past year

F. Equipment

- Numbers of axes, knives, fishing gear, etc

3.3.2.3 Sampling frame for household data

A total of 430 households from 12 villages in five zones were surveyed (Table 3-2).

Table 3-2 Number and location of household questionnaires completed

Area	Village	No of questionnaires administered	Total for each area
1. North (Panhandle)	Shakawe	34	109
	Ngarange	32	
	Kauxwi	17	
	Sepopa	18	
2. West	Gumare	60	81
	Nokaneng	21	
3. South-west	Sehitwa	56	95
	Toteng	38	
4. South-east	Shorobe	30	96
	Maun	66	
5. Central (Delta)	Jao	21	49
	Sankuyu	28	
Total			**430**

Table 3-3 Focus group discussions carried out during the study

Topic	North Shakawe	West Gumare	South-west Sehitwa	South-East Maun	Central Sankuyu
Fishing	✓				
Crops	✓	✓	✓	✓	
Livestock	✓	✓	✓	✓	
Natural Resources-Men	✓	✓	✓	✓	
Natural Resources – Women	✓	✓	✓	✓	
Tourism					✓

3.3.2.4 Contribution of resources to household income and aggregate values

The value of each resource was estimated using a spreadsheet model. This model was similar to the one originally developed by the Namibian Directorate of Environment Affairs (e.g. Ashley *et al*. 1994, Barnes & de Jager 1996, Ashley & Barnes 1996, Barnes 1996), and since adapted for use in Turpie *et al*. 1999 (Zambezi basin), Turpie 2000 (Rufiji, Tanzania) and Turpie & Egoh 2003 (Caprivi). The model estimates the current annual financial (private) and economic (societal) costs and returns to natural resource use and agricultural activities as well as total annual production of each type of product.

The above model was also designed to estimate total household income and the contribution of different areas of production (e.g. natural resources) to this income.

3.3.3 Indirect use values

A considerable part of the wetland literature has focused on the indirect use values of mangrove wetlands (Barbier *et al*, 1997; Spaninks and Van Beukering, 1997). In theory, indirect use values can be measured by CVM, cost-based approach and production impacts (Barbier *et al*, 1997; Spaninks and Van Beukering, 1997; World Bank, 1998). In practice, most empirical studies do not value *all* indirect uses, and where they value, they use cost-based methods, and sometimes the effects on (lost) production:

- Damage costs avoided;
- Preventive and mitigation measures,
- Replacement costs; and
- Effects on production (through estimated changes in uses)

In this study, five main ecosystem functions were identified as being important in the generation of indirect use value: groundwater recharge, wildlife refuge, carbon sequestration, water purification and scientific and educational value. Recharge value was estimated as the value of groundwater abstraction immediately around the wetland. Carbon sequestration was estimated using published rates of sequestration applied to different habitat types, and using published values of carbon. Wildlife refuge value was estimated by estimating the hunting value of animals that were hunted beyond the delta but whose presence in those areas was attributed to the delta. Water purification value was estimated by calculating the input of pollutants and estimating what the artificial treatment cost of this quantity of effluent would be. Scientific and recreational value was estimated on the basis of the expenditure on these activities in the study area.

3.3.4 Option and existence value

Option and existence value are measured using the contingent valuation method (CVM), which requires extensive data collection, and has many potential problems. Such a study was beyond the scope of this study, thus option and existence value were not estimated. However, a short discussion on these values is included in the results sections for completeness.

3.4 Value of the Okavango Delta in the economy of Botswana

This section considers the aggregate effects of the Okavango Delta in terms of the total economic value of the delta, its impact on rural livelihoods and its macroeconomic impact. We also estimate the natural asset value of the Okavango delta using a natural resource accounting approach.

3.4.1 Total economic value

Total economic value of the delta is considered in terms of the direct gross output (= gross value added), the direct contribution to national product and the economic resource rent generated by each use. The resource rent is calculated from the resource use enterprise models and data. Resource rent is economic rent and defined as the gross output less the costs of production plus a reasonable return to capital. It is commonly referred to as excess profit in the literature. It is used in the calculation of the value of the Ramsar site and the wetland as natural assets.

3.4.2 Direct impact on rural livelihoods

The direct impact on rural livelihoods was estimated in terms of the income (subsistence and cash value) generated by agriculture, natural resource harvesting and through tourism. Tourism income was calculated in terms of the amount of income generated in salaries and wages by tourism enterprises, as well as the amount paid to local communities in the form of rentals and royalties. The latter estimates were generated using enterprise models.

3.4.3 Macroeconomic impact

The direct impacts described above were translated into total impacts on the economy, i.e. value added to gross national product (GNP), using a Social Accounting Matrix (SAM). The SAM is an economic tool designed for economic impact analysis. The SAM expands the national accounts in the format of a table that shows the linkages among all components of an economy: production and

generation of income, distribution of income, expenditures, savings and investment, and foreign trade. Because the SAM provides detailed information about different types of households - how they receive and spend their income – it is used to analyse the distributional impacts of policy, that is, the effects on employment, incomes and poverty of different industries and household groups. Botswana has had several SAM models in the past, most recently for 1995/96. Using the most recent Household Income and Expenditure Survey, a new SAM for 2002/2003 was constructed for Botswana (Thurlow, 2006). This basic SAM has been expanded to analyse economic activities in the Okavango Delta for our study. A detailed description of the SAM framework, our Ramsar site SAM model, and the mathematical model used for calculations is provided in Appendix 5.

3.4.4 Natural asset value of the Okavango Delta

The approach used in this study is aimed at making the values estimated compatible with the system of national accounts used in Botswana. As a supplement to the national accounts Botswana has developed a number of natural resource accounts (NRA) for various natural assets such as water and minerals. Natural resources are not conventionally included as assets in the national accounts, but the NRA supplementary data which is very useful to assist with sustainable development planning.

Botswana's NRA programme follows the approach espoused by the UN (UN, EC, IMF, OECD & WB, 2003), described by Lange et al. (2003). NRA consist of two components, the production or flow accounts, and the asset accounts. The production accounts measure the use value, in terms of the GNP contribution, of the natural resources each year, and as such are normally included in the national accounts. The direct economic value of the delta described above represents the production accounts for 2005 for the natural resources of the Okavango delta. These show the annual resource rents generated by each activity. The asset accounts for natural resources measure the value of the natural resource stocks as capital asset. These are not normally included in the national accounts, which take account only of owned or produced capital.

In the NRA system of the UN, EC, IMF, OECD & WB (2003), natural assets are valued according to the predicted flow of economic rent (resource rent) from the asset base. Only those future rents that are feasible, given economic and policy constraints in the national context are included. NRA are commonly developed for individual resources, such as fish wildlife and forests, to help with sectoral planning. However, they can also be approached from the point of view of land accounts or ecosystem accounts (Weber, 2006). We have used this approach to value the natural asset value of the Ramsar site and the wetland. Thus we have made predictions of the future likely streams of resource rents from each activity and discounted these streams to get asset value. These were calculated from enterprise models, using a fixed 30 year time span for the analysis.

3.5 Analysis of management scenarios

Available planning information and stakeholder opinions on the main issues in the study area were reviewed and a list of simple scenarios was compiled in order to examine the potential impacts of different scenarios on the economic value of the study area. This was conducted at an extremely coarse scale. The biophysical changes under the different scenarios were estimated, and the impacts of these changes were calculated on the basis of simple assumptions on the relationships between resource characteristics and value.

4 DIRECT USE VALUE: TOURISM

4.1 General overview of tourism

The economic growth that has taken place in Botswana since the 1970s, following the discovery of diamonds, saw improved infrastructure and access and increased investor confidence and paved the way for the subsequent growth of the tourism industry in the country (Boggs 2004). The wildlife-based tourism industry is now Botswana's second largest income earner after diamond mining, contributing 5.0% to the country's Gross Domestic Product (Mbaiwa 2005). It accounts for 40% of employment opportunities in northern Botswana[1]. Botswana's first Tourism Policy of 1990 pursued a high value/low volume tourism strategy, which included differential pricing with high prices for foreigners, limiting park access to 4x4 vehicles, limiting the size of lodges and camps to a maximum of 16 beds and limiting the number of camp sites inside protected areas. This policy has been particularly successful in the northern reserves (Moremi and Chobe; Magole & Gojamang 2005).

The Okavango delta is a unique feature and is Botswana's major tourist attraction. Tourism in the area was almost non-existent in the 1970s (Campbell & von Richer 1976). Since then it has grown dramatically, with the establishment of large numbers of tourism lodges in the area and further use by numerous mobile safari operators. The delta is estimated to receive about 50 000 tourists annually (Mbaiwa 2002).

The first photographic safari lodges were established in Botswana in the late 1960s to early 1970s. Before that Botswana was mainly a hunting safari destination (Magole & Gojamang 2005). Today there are approximately 2 hotels, 9 guesthouses and 93 lodges/camps in the study area. In addition, there are at least 70 mobile safari operators leading tours into the area (Appendix 2). Tourism is centred on the Moremi Game Reserve and the surrounding Wildlife Management Areas, with most access being via the growing settlement of Maun, where many of the abovementioned operations are based.

The Moremi Game Reserve, established in 1963, is Botswana's second most important protected area in terms of revenue generation, with almost 40 000 visitors in 2003. Tourism use is non-consumptive, and includes camping, boating and walking trails as well as conventional game viewing. The Moremi Game Reserve brought in revenues of P7.335 million in 2003 (Mbaiwa 2005). None of these revenues are shared with local communities, who are also not involved in the management of the reserve, although members of the Khwai community were displaced when the reserve was established (Mbaiwa 2005). Tourist numbers have increased dramatically over the last three decades, from 4500 people in 1971 (Mbaiwa 2005), and reaching nearly 50 000 visitors in 1998. This trend is probably true for the area in general, with the slow-down in tourism in the last 7 years being ascribed to the problems in Zimbabwe, as well as international upsets such as the 2001 bombing of the World Trade Centre. Facilities in the reserve have also grown over time and now include three safari lodges (Okuti, Moremi and Moremi Safaris) and 10 private camp sites as well as the four public camping sites. The reserve accounts for some 30% of visits to national parks in Botswana. Visitors to fixed lodges accounted for about 40-50% of total visitations to protected areas in 1995 – 2000, but this proportion has been declining over the past 10 years as the numbers of mobile safari tourists have increased to 30-40%. Private tourists make up the remainder. Fixed lodge tourists are the highest income visitors who also spend the most on their visits, compared with mobile safari tourists who are medium-high income visitors. The loss of exclusivity in protected areas may have caused the elite tourists to seek fresh destinations elsewhere (Magole & Gojamang 2005).

Outside Moremi, the tourism industry is centred on photographic safari camps and hunting safari camps in the Wildlife Management Areas surrounding the game reserve. The photographic safari camps are mostly luxury tented camps, whereas the hunting camps are often more basic. There are also a handful of fishing camps in the area. All of the camps within WMAs are temporary structures which may be removed with very little trace once the leases have expired. Companies owning camps

[1] http://www.safaribwana.com/COUNTRIES/Botswana/indexbwa.htm

within commercial WMAs pay a lease to the local government land board. This fee is calculated as a percentage of the company's turnover. Companies with camps within community WMAs (described below) pay a lease directly to the community, as well as royalties for hunting.

The Wildlife Conservation and National Parks Act of 1992 gave rise to Botswana's Community Based Natural Resource Management (CBNRM) Programme in which the control of natural resources is devolved to the communities. Between 1993 and 2002, community management areas (CMAs) were assigned within some of the previously designated wildlife management areas (WMAs), and zoned for multiple use of natural resources (both consumptive and non-consumptive). Management plans were produced for each CMA (Boggs 2004). The recipient communities (existing residents or closest neighbours) were identified, were required to elect a council or board, and register as a trust or community-based organisation (CBO) as a 'representative and accountable legal entity' (RALE). The community then had to apply to DWNP for a wildlife hunting quota that would be managed by the RALE (Boggs 2004). Communities were then encouraged to enter into a joint venture agreement (JVA) with commercial operators, and to enter into 15 year leases with safari operators to manage photographic or hunting operations. In practice the leases were broken down into short term contracts of 1 – 5 years. Under these JVAs, communities receive revenues from lease payments and land rental, wages and rations, community development funds and game quota fees. In some cases, communities do not enter into JVAs but opt to sell their annual wildlife quota from DWNP on auction to individual safari hunters and safari companies. For example, the Khwai Development Trust earned P550 000 to P1.2 million per year in this way from 2000 to 2002, although it is considered that revenues would be higher under a JVA (Mbaiwa 2005).

The CBNRM programme differs from other regional programmes such as in Zimbabwe and Zambia, in that most revenue is returned to and controlled by the community rather than the state. It is largely considered to be successful in Botswana. The benefits from CBNRM in terms of income generation, employment and local participation in wildlife management are leading to the development of positive attitudes of local communities towards wildlife conservation and tourism development in communities such as at Khwai (NG18/19; Mbaiwa 2005). However, it should be noted that in some cases the income from CBNRM has been sporadic, due to problems associated with bad relationships between communities and operators, or within communities, and problems are largely associated with the short duration of the contracts (Boggs 2004).

4.2 Seasonality and prices

Tourism in the Okavango delta area is strongly seasonal, with the high season being from July to October, and the low season from November to April, although there is a slight increase in activity over the Christmas period. Occupancy is reportedly very low during the off season, during which regional tourists are enticed with cheaper packages. The seasonality is strongly reflected in the price changes (Figure 4-1).

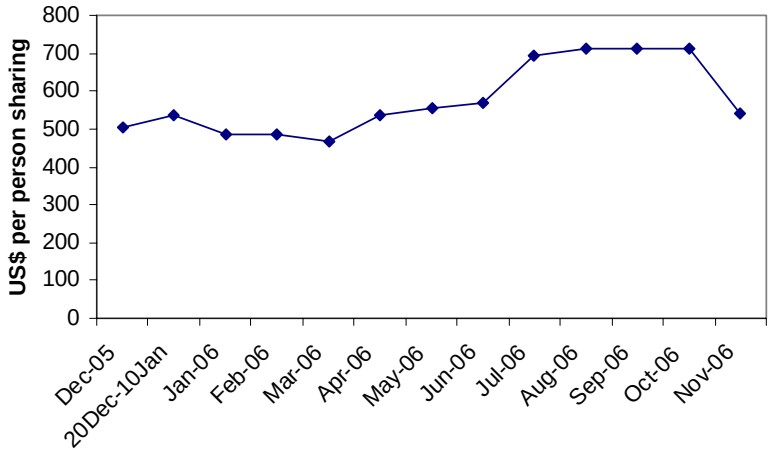

Figure 4-1. Changes in the average price of photographic tourism camps in the Okavango Delta area (n = 26 camps)

4.3 Tourism economic value

Tourism in the Okavango Delta Ramsar Site is estimated to generate direct output of P1 115 million, and directly contributes some P401 million to the GDP (Table 4-1). These values can be compared with the other direct use values of the delta presented in the following section.

The results in Table 4-1 represent the gross output (turnover) and the gross value added (GDP contribution) resulting from turnover generated by tourism in the study area. They represent the direct first-round expenditures of tourists on tourism facilities, as well as associated linkages (see below). They do not include any indirect impacts, which also result in the broader economy, from these tourism expenditures due to the multiplier effect. These are discussed in a later chapter.

Table 4-1 Estimated value of annual gross output and gross value added in the Okavango delta-based tourism industry using three methods, and average value used in this study (P million, 2005)

	Method 1		Method 2		Method 3		Average	
	Gross output	Gross Value added	Gross output	Gross value added	Gross output	Gross value added	Gross output	Gross value added
Non-consumptive tourism	910.8	320.7	853.0	340.8	935.3	270.4	**899.7**	**310.6**
Hunting tourism	151.5	58.1	170.9	77.9	195.2	65.5	**172.5**	**67.2**
CBNRM tourism	20.9	12.7	46.1	20.0	53.3	17.7	**40.1**	**16.8**
TOTAL	**1 093.6**	**403.5**	**1 070.0**	**442.9**	**1 183.8**	**356.5**	**1 115.8**	**401.0**

Tables 4-3 and 4-3 show average values of the gross output, gross value added (gross national product contribution) and economic resource rent produced in Okavango delta-based tourism broken down by type of product. The products are the different services that tourists visiting the delta spend money on, and include accommodation and various linked services. The tables show values for the Ramsar site as a whole as well as for the wetland part of the site only. It can be seen that the wetland produced some 90% of the GNP contribution of the Ramsar site as a whole.

Table 4-2 Estimated direct gross output, direct contribution to the gross national product and the economic natural resource rent produced as a result of tourism activities in the Ramsar site (Pula'000, 2005)

RAMSAR SITE Direct use values	Direct gross output	Direct GNP Contribution	Natural Resource rent
Tourism accommodation			
Lodges/Camps (non-consumptive)	445 580	209 460	102 480
Camps (trophy hunting)	103 190	56 890	29 930
Mobile & self-drive safaris	93 290	43 230	18 660
Guest houses, B&Bs, motels	19 660	12 240	4 520
Hotels	13 640	6 170	2 860
Tourism linked activities			
Restaurants/bars (independent)	110 180	15 930	7 710
Transport (air charter, airline, road)	105 480	17 980	8 440
Travel agents, guiding services	47 220	9 470	4 250
Shopping	166 590	24 270	11 660
Additional CBNRM income	10 980	5 330	1 100
TOTAL RAMSAR SITE TOURISM	**1 115 810**	**400 970**	**191 610**

Table 4-3 Estimated direct gross output, direct contribution to the gross national product and the economic natural resource rent produced as a result of tourism activities in the wetland (Pula'000, 2005)

WETLAND **Direct use values**	**Direct** **gross output**	**Direct GNP** **Contribution**	**Natural** **Resource rent**
Tourism accommodation			
Lodges/Camps (non-consumptive)	422 340	198 520	97 140
Camps (trophy hunting)	73 200	40 290	21 230
Mobile & self-drive safaris	88 340	40 940	17 670
Guest houses, B&Bs, motels	18 180	11 330	4 180
Hotels	12 320	5 510	2 590
Tourism linked activities			
Restaurants/bars (independent)	99 470	14 390	6 960
Transport (air charter, airline, road)	95 170	16 230	7 610
Travel agents, guiding services	43 730	9 090	3 940
Shopping	150 460	21 940	10 530
Additional CBNRM income	9 330	4 530	930
TOTAL FOR WETLAND TOURISM	**1 012 530**	**362 760**	**172 780**

5 DIRECT USE VALUE: HOUSEHOLD USE OF NATURAL RESOURCES

5.1 Household characteristics

Average household size in the study area ranged from 7.2 in the Panhandle area to 8.3 in the West and South-east areas, excluding household members living away from home (Table 5-1). These are large households in general.

Table 5-1 Average household size and composition in the different zones of the study area

	Panhandle	West	South West	South East	Central
Adults living here	3.2	3.7	3.6	4.4	3.5
Adults living away	1.2	1.6	1.6	1.4	1.5
Children 5-17 years	2.9	3.1	2.7	2.8	2.6
Children 0-5 years	1.1	1.5	1.2	1.2	1.3
Total number living here	**7.2**	**8.3**	**7.5**	**8.3**	**7.3**

About 21 - 34% of the adults belonging to households in the study area are formally employed (Table 5-2). Tourism and the DWNP account for 60% of jobs in the central (delta) area, and 19% in the South East (Maun) area, but is a relatively small employer to the west of the delta. Government is by far the main employer in the area, accounting for 40 – 66% of jobs in most areas apart from the central area. Farming is the next beiggest employer in the Panhandle and west areas. The fishing sector is a very small employer, only in the Panhandle area, and trade in natural and agricultural products provides employment opportunities to a few (Table 5-2). The “other” category includes occupations such as cleaner, shop assistant, etc.

There are about 3 to 4 dwellings per household throughout the study area (Table 5-3). The amount of households that have brick dwellings varies from area to area, from less than half of households in the panhandle and central areas, and over 70% of household in the remaining areas (Table 5-3). Nevertheless, brick dwellings only make up about 20 to 50% of dwellings in the different areas, with the majority of dwellings being made of poles and reeds with mud. Reed structures are most prevalent in the panhandle area and the adjacent west area where reeds are in greatest abundance (Table 5-3).

Table 5-2 Percentage of adults in formal employment and the percentage of jobs in different occupations

	Panhandle	West	South West	South East	Central
% adults in formal employment	26	24	21	31	34
Tourism	4	0	1	16	55
DWNP	4	0	0	3	5
Other Government	41	58	66	43	16
Farming	15	12	1	1	0
Fishing	3	0	0	0	0
Trade in natural resources	7	1	0	0	0
Trade in agric. products	3	2	1	0	1
Other	23	27	31	38	23

Table 5-3 Average numbers of dwellings per household, and the percentage of different types of dwellings in each area

	Panhandle	West	South West	South East	Central
No. dwellings per hh	4.0	4.0	3.3	4.1	4.2
% households that have one or more brick houses	45	73	75	85	48
% Brick structures	20	40	42	49	21
% Mud and pole structures	44	42	48	42	54
% Reed structures	35	18	9	9	25

A relatively small proportion of households have electricity as their main source of lighting, and these area mainly in the west and south east areas where there has been significant urban development. Most households rely on paraffin for lighting, but the more way-out areas of the panhandle and central (delta) areas are also fairly reliant on candles for lighting.

Table 5-4 Percentage households with different types of lighting

	Panhandle	West	South West	South East	Central
Electricity	8	22	17	34	-
Paraffin	33	69	74	57	71
Candles	53	6	7	8	22
Firewood	5	2	1	-	6
Other	1	-	-	-	-

Nearly all households rely on fuelwood as a source of energy for cooking, the fewest being in the south-east (Maun) where far more households use gas as the main energy source (Table 5-5).

Table 5-5 Percentage households using different sources of energy for cooking

	Panhandle	West	South West	South East	Central
Firewood	89	84	88	73	92
Gas	7	15	12	25	8
Electricity	3	1	-	2	-
Generator	1	-	-	-	-

5.2 Overview of household livelihoods

Households in the study area traditionally derive their livelihoods from a variety of sources (Rashem 1988):

- gathering, hunting and fishing,
- livestock
- arable farming
- crafts, and
- the formal sector.

This multisectoral livelihood system allows households to spread risk, so that there is something to fall back on in years of crop failure or livestock death. The livestock sector is by far the most important contributor to rural subsistence and cash income, although there is some concern that it cannot maintain this status due to population growth and degradation of pasture lands (Rashem 1988).

Arable farming is largely carried out for subsistence purposes, with only 3% of households in the study area engaged in commercial farming (this study). Farming systems are extensive with minimal inputs, providing a fair return in good years and no return in bad years, but without incurring massive losses in years when crops fail (Rashem 1988). Thus several years may go by when households generate little or no crop outputs. It is estimated that the probability of obtaining no yield from dryland farming is 60% (Rashem 1988). Arable farming is thus of much less importance than livestock and other sectors in this area. In this study, revenues from livestock are estimated to be far greater than those from crops, for the average household. In 1982/3, revenues from livestock were 17 times that of crops during a drought year (Rashem 1988). However, it should be noted of course that crops are grown mainly for own consumption, not for sale.

In former times, gathering, hunting and fishing may have been the main sources of household livelihoods, providing as much as 70% of food (Tlou 1984, Rashem 1988). This sector has declined in importance because of the depletion of resources and loss of natural habitats. This is partly due to the breakdown of traditional systems to protect them, but also due to population growth and increasing demand for resources (Rashem 1988). Nevertheless, this sector is still important, especially during drought years. Government support and improved markets for crop and livestock products has undoubtedly been the major factor in the evolution of the current household livelihood strategies away from reliance on the natural resource base. Crafts, including basketry and woodwork, have generally also declined in importance, even though the importance of some products such as baskets has increased due to external efforts. The general trend is because of increased availability of substitutes which has decreased local or domestic demand for these products. Craft-oriented development projects attempt to increase demand for these products from tourists instead.

The formal sector has become increasingly important in recent years, and is the most desirable to households in terms of the level and stability of income that it provides (Rashem 1988). However, this sector can only accommodate a limited number of households. About 17% of households receive income from the formal sector.

The following sections provide quantitative estimates of the contributions made by agriculture and the use of natural resources in the study area.

5.3 Agricultural activities

There are three main types of farming practised in the study area (Rashem 1988):

- Pastoralism, practised by most but as a the main activity of the Maherero,
- Dryland farming, practised mainly by the Hambukushu, and
- Molapo farming, practised mainly by the Bayei.

5.3.1 Livestock

Livestock is considered to be the most important agricultural activity. This is the most important source of cash income, and cattle also provide meat, milk, draught power, wealth store and social status. Nevertheless, some households are primarily crop farmers and keep only small herds, primarily for draught power.

Livestock tend to be kept away from villages at cattle posts, which centre around water points, mainly boreholes. However, some households keep their livestock in the village. It is considered preferable to keep livestock at cattle posts, where they are less susceptible to disease and cause less damage to crops. Livestock production is extensive, with very little in the way of inputs.

Households with livestock at cattle posts have larger herds, with an average of 32 cattle, 28 small stock, and 6 donkeys/horses. In comparison, those that keep their livestock in the village have an average of less than 5 cattle, 16 small stock, and 3 donkeys/horses (Table 5-6).

Table 5-6. Average number and production of stock for households with livestock at cattle posts versus those with livestock kept in village. Production and percentages are relative to standing stock.

		Pan-handle	West	South West	South East	Central	Overall
Livestock at cattle post							
Cattle		37.7	21.7	29.7	42.2	2.0	31.9
	% consumed	*2.1*	*2.1*	*1.7*	*1.4*	-	*1.7*
	% sold	*4.3*	*13.7*	*9.5*	*8.1*	-	*8.8*
Small stock (goats + sheep)		15.8	27.5	23.6	38.6	2.0	27.5
	% consumed	*62.4*	*47.9*	*37.4*	*14.8*	-	*32.7*
	% sold	*46.2*	*47.1*	*66.9*	*9.0*	-	*35.9*
Donkeys		3.8	4.0	4.1	4.2	0.8	4.0
	% consumed	*11.3*	*11.7*	*5.1*	-	-	*6.0*
	% sold	*22.6*	*40.8*	-	-	-	*13.5*
Horses		0.4	1.9	3.3	1.8	-	2.0
Livestock in village							
Cattle		4.6	16.9	1.0	2.6	1.1	4.5
	% consumed	*5.9*	*1.5*	*9.5*	-	-	*3.5*
	% sold	*3.2*	*2.0*	*14.3*	*2.9*	-	*3.0*
Small stock (goats + sheep)		6.4	31.4	29.4	16.2	7.3	15.5
	% consumed	*22.8*	*12.7*	*35.2*	*17.1*	*30.8*	*25.3*
	% sold	*54.8*	*12.7*	*26.0*	-	-	*22.3*
Donkeys		2.8	3.1	2.0	7.0	0.3	2.8
	% consumed	*20.7*	-	-	-	-	*8.2*
	% sold	-	-	-	*39.6*	-	*12.2*
Horses		0.3	0.3	0.1	0.2	-	0.2
LSUs at posts		39,630	41,721	30,556	215,357	52	327,316
LSUs in villages		11,416	7,763	2,293	10,898	171	32,540
TOTAL		51,046	49,484	32,849	226,255	223	654,633

Note that these figures may be underestimates, since there is a known tendency for rural households to underestimate the number of livestock that they own. Based on this study, there are a total of about 655 000 Large Stock Units (LSUs) in the study area. However, it must be noted that livestock numbers are currently recovering from the CBPP set-back of 1995-6 (Bendson & Meyer 2002).

Livestock farming is most prevalent in the West, South West and South East of the study area, and in these areas, at least two thirds of livestock owning households keep their livestock at cattle posts. While livestock are still prevalent in the panhandle area, more households keep their cattle in the village areas than out at cattle posts. In the central zone, only about 40% of households have livestock, and these are mostly kept around the villages.

Livestock kept around villages mostly rely on natural water sources, whereas 65% of households with cattle at posts rely on boreholes for water supply (Table 5-7).

Livestock kept out at cattle posts tend to be have a larger component of lower-priced stock, but tend to provide a much larger income per household because of the herd sizes involved (Table 5-8, Table 5-9). Overall, the value of cattle is estimated to be some P29 million in terms of net income, with an estimated direct economic value of about P34 million. 88% of the net income and 83% of the economic value is derived from cattle posts.

Table 5-7 Percentage livestock farming households that rely on different sources of water, separated into households that have livestock at cattle posts versus around the villages.

	Panhandle	West	South West	South East	Central	Overall
Livestock at cattle post						
Own borehole	19	48	33	31	25	34
Hired borehole	4	-	14	18	-	10
Shared borehole	17	8	33	22	-	21
Natural water source	61	43	20	29	75	35
Dug well	-	5	-	3	-	2
Livestock in village						
Own borehole	-	25	-	-	50	9
Shared borehole	3	-	50	-	-	4
Natural water source	97	53	50	100	50	82
Dug well	-	22	-	-	-	5

Table 5-8. Estimated value of livestock production at cattle posts.

Livestock – cattle posts		% hh	Produced (LSUs)	Sold (LSUs)	Price per LSU	Gross private value	Net private value	Cash Income	Net economic value
N	Per producer hh	25	7	4	1,243	9,756	7,543	4,571	4,977
	Total		5,822	3,277		8,690,156	6,719,681	4,072,056	4,433,170
W	Per producer hh	63	10	7	1,237	13,937	12,148	8,682	9,886
	Total		13,427	9,087		18,041,319	15,726,374	11,238,554	12,797,102
SW	Per producer hh	61	8	6	1,423	12,552	10,416	8,066	7,811
	Total		5,829	4,212		9,329,464	7,741,785	5,995,213	5,805,771
SE	Per producer hh	61	6	4	1,243	8,868	6,181	4,952	2,876
	Total		21,706	15,695		34,942,198	24,356,417	19,512,662	11,333,278
C	Per producer hh	8				117	-30	-	-217
	Total					1,963	-508	-	-3,648
	TOTAL (P, 2005)		43,784	32,271		71,005,101	54,543,748	40,818,484	34,365,674

Table 5-9. Estimated value of livestock production in villages

Livestock – village areas		% hh	Produced (LSUs)	Sold (LSUs)	Price per LSU	Gross private value	Net private value	Cash Income	Net economic value
N	Per producer hh	36.9	1.25	0.73	1542	2,581	2,137	1,128	1,1875
	Total		1,624	955		3,366,472	2,787,572	1,471,885	2,445,526
W	Per producer hh	14.8	1.92	1.00	1566	5,579	4,417	1,566	3,475
	Total		584	305		1,699,270	1,345,247	476,887	1,058,348
SW	Per producer hh	23.40	3.23	1.41	1746	6,284	5,805	2,640	5,429
	Total		926	404		1,802,692	1,665,397	705,697	1,557,426
SE	Per producer hh	13.5	0.55	0.09	1652	1,523	905	154	351
	Total		482	81		1,321,980	786,185	133,538	304,874
C	Per producer hh	33	0.38	-	1217	778	572	-	391
	Total		10	-		51,267	37,681	-	25,780
	TOTAL (P, 2005)		3,626	1,744		8,241,681	6,622,083	2,788,007	5,391,924

5.3.2 Cropping

Some 75% of households in the study area are crop farmers. About 47% of households have dryland fields, and a further 28% have molapo fields. Very few households have both. Fields are small and dryland and molapo fields were not significantly different in size per household. It was estimated that about 14 500 ha were planted in the study area in the 2004/5 crop season. Note that this was a dry year, and the area may increase in wetter years. Most arable agriculture in the study area is dryland farming, which makes up about 80% of the area planted (Table 5-10). Molapo farming takes place on seasonally flooded areas or areas that are moistened by rising groundwater.

Table 5-10 Proportion of households with dryland and molapo fields, area planted per household and estimated total area planted in the different zones during 2004/5.

	Pan-handle	West	South West	South East	Central	Total
% hh with dryland fields	66.1	19.7	43.4	53.8	45.3	46.7
Average dryland area planted	1.90	1.34	1.16	1.71	1.12	1.90
% hh with molapo fields	6.0	55.6	32.1	21.2	30.2	27.8
Average molapo area planted	2.11	0.93	0.83	0.75	0.41	2.11
Dryland area planted (ha)	4,435	543	617	5,899	102	11,596
Molapo area planted (ha)	447	1,063	327	1,019	25	2,881
Total area planted (ha)	**4,882**	**1,606**	**944**	**6,918**	**127**	**14,477**

The main crops grown are maize, millet and sorghum, which are sown together with a variety of other crops such as groundnuts and beans. Millet and maize are staple foods, whereas sorghum is grown mainly for brewing beer. Maize is more reliant on water, and tends to fail in poor rainfall years. Maize production is considerably higher on molapo fields than on dryland fields (Table 5-11, Table 5-12), while millet, sorghum and bean production is generally higher on dryland fields. Sweet reed production also tends to be higher on molapo fields. Average yields reported in this study were low, largely because of the drought and the fact that many households reported failed crops. Nevertheless, the grain yields found in this study were in the same order of magnitude of yields reported in Rashem (1988; about 250kg/ha) and for Ngamiland (Agricultural statistics 1968-1998: about 142 kg/ha).

Table 5-11 Average production per ha of the main crops grown in dryland fields in 2005. Note that the total of all crops is per ha.

Dryland crop	Unit	Approx. Price Per unit	Zone 1 N	Zone 2 W	Zone 3 SW	Zone 4 SE	Zone 5 C
Maize	Kg	2.4	74.16	152.35	53.25	73.37	48.32
Millet	Kg	0.8	74.90	-	0.43	18.91	3.74
Sorghum	Kg	0.8	67.75	-	9.81	29.28	4.46
Groundnuts	Kg	5.0	7.72	3.43	-	6.85	-
Beans	Kg	5.0	10.19	21.79	6.28	15.23	1.69
Melons	each	10.0	3.05	2.84	9.21	1.35	0.45
Pumpkins	each	12.5	7.09	19.40	0.17	2.93	-
Sweet reeds	each	1.0	68.33	31.11	394.01	58.50	147.37

Inputs into farming are small. Most fields are ploughed with donkeys, and relatively few use oxen (Table 5-13), these households requiring a plough with yokes and chains. A fair proportion of households use tractors for ploughing, but a significant proportion use only hoes. Some of the required seed input (10kg per ha) is obtained free from the government, and implements such as

ploughs are subsidised by 85%. Molapo farming is reportedly more reliant on livestock than dryland agriculture (Rashem 1988) but this was not evident in this study.

Table 5-12 Average production per ha of the main crops grown in molapo fields in 2005. Note that the total of all crops is per ha.

Molapo crop	Unit	Approx. Price per unit	Pan-handle	West	South West	South East	Central
Maize	Kg	2.4	107.32	285.93	77.23	189.88	101.43
Millet	Kg	0.8	47.01	4.60	-	28.40	-
Sorghum	Kg	0.8	-	10.29	-	9.38	-
Groundnuts	Kg	5.0	-	1.69	1.07	-	1.30
Beans	Kg	5.0	4.72	20.45	5.08	14.32	6.62
Melons	each	10.0	13.95	2.90	1.60	1.48	0.24
Pumpkins	each	12.5	-	43.20	-	35.06	7.33
Sweet reeds	each	1.0	47.01	225.67	385.60	452.59	145.06

Table 5-13 Percentage farming households that ploughed with tractors, donkeys, oxen and hoes

Ploughed with	Dryland farming	Molapo farming
Tractor	13	9
Donkeys	60	68
Oxen	14	4
Hoe	13	19

Dryland and molapo farming are worth about P6.5 million and P2.6 million in net income to households in the study area, respectively, with relatively little of this being translated into cash income (Table 5-14, Table 5-15). Dryland farming generates the highest value to households in the panhandle and Maun areas, of over P1000 per year. Molapo farming generates similar value to households, being highest in the Maun area. The economic value of arable agriculture in the study area was estimated to be in the order of P6 million in 2005. However, it should be noted that this was a drought year, and many households did not harvest that year.

Table 5-14 Average value of production of dryland farming in 2005.

Dryland crops		% hh	Gross private value	Net private value	Cash Income	Net economic value
N	Per producer hh	66.1	1,096	771	227	289
	Total		2,555,887	1,797,892	528,729	673,987
W	Per producer hh	19.7	620	820	-	405
	Total		431,920	332,514	-	164,070
SW	Per producer hh	43.4	770	600	58	320
	Total		409,644	319,151	31,089	170,382
SE	Per producer hh	53.8	745	503	80	114
	Total		2,569,663	1,733,447	275,932	391,331
C	Per producer hh	45.3	318	162	-	-28
	Total		29,050	14,845	-	-2,553
	TOTAL (P, 2005)		5,996,164	4,197,846	835,751	1,399,770

Table 5-15. Average value of production of molapo farming in 2005.

Molapo crops		% hh	Gross private value	Net private value	Cash Income	Net economic value
N	Per producer hh	6.0	473	205	3	22
	Total		100,225	43,375	530	4,644
W	Per producer hh	55.6	1,327	1,182	154	920
	Total		1,516,322	1,350,992	176,057	1,050,912
SW	Per producer hh	32.1	462	328	1	14
	Total		181,922	129,373	542	5,417
SE	Per producer hh	21.2	594	474	35	210
	Total		808,390	644,534	48,209	286,088
C	Per producer hh	30.2	442	383	3	356
	Total		26,968	23,377	203	21,703
	TOTAL (P, 2005)		2,633,828	2,191,651	225,542	1,368,763

5.4 Use of natural resources

This section describes the use of natural resources within the study area, the degree to which rural households are involved in harvesting and processing these resources, estimates of quantities of harvests and production of natural resource products, and their value. Natural resources are presented roughly in 'taxonomic' order (order of organism complexity). The use and value of each of these products is explained and discussed in detail in the following sections. Quantities and values are presented in this section at the level or the user or producer household in each area, the aggregate for the zone, and for the study area as a whole.

5.4.1 Participation in natural resource use

Several natural resources are harvested in the study area, many of which are used or processed by a high proportion of households in the study area (Table 5-16).

Table 5-16. Percentage of households engaged in different natural resource-related activities (household survey data).

Activity	Panhandle	West	South West	South East	Central
Pottery	3	0	2	1	0
Wetland grasses	61	21	2	5	18
Upland grasses	8	12	18	16	35
Reeds	69	33	7	18	22
Papyrus	10	1	0	1	12
Palm leaves	12	42	7	29	41
Wild foods	57	53	64	57	65
Medicinal plants	12	12	19	16	10
Firewood	77	86	98	85	96
Timber	1	1	0	1	0
Poles & withies	49	28	34	28	47
Fish	34	6	4	6	20
Honey	2	1	1	2	2
Hunting*	36	49	43	42	61

*assuming a 10% reporting rate

Several laws regulate the use of natural resources in Botswana. Apart from gazetted forest reserves, which are governed by the Forest Act, and which do not occur in the study area, veld products such as thatching grass, reeds and fuel wood are managed by local communities. However, these management systems have become weak as a result of loss of power of traditional leadership as well as increasing subsistence and commercial demand for resources. Hunting is a licensed activity regulated by the Wildlife Conservation and National Parks Act, and penalties are strictly enforced in Botswana. Fishery resources are regulated by the Fish Protection Act.

Despite this, there is concern that many of the natural resources of the study area are being overexploited. This is at least partly due to the fact that the poor households in this district have a high dependency on natural resources. The supply of resources has also been affected by reduction in the duration and intensity of flooding over the past two decades (TLB 2006, Kgathi *et al*. 2005).

5.4.2 Clay and pottery

Clay is usually collected from termite mounds around villages, and used in construction or production of pottery. However, the availability and use of clay is extremely limited in the study area, with only 1.4% of households involved in this activity. A similar trend was reported in Caprivi, where the general consensus was that pottery has died out as a result of the availability of plastic containers and other merchandise (Turpie & Egoh 2003). In this study, pottery was reported in Zones 1, 3 and 4, but earned producers only P20 – 50 per annum. Pottery was thus considered to be rather a negligible activity in terms of income to households from natural resources.

5.4.3 Grasses

Grasses are used extensively throughout the study area for thatching and construction of fences. Grasses are collected both from upland areas and the wetlands.

Grasses are mainly used for thatching. Based on the number of dwellings thatched in the last year, it is estimated that roofs are thatched every 8 years on average, though this may vary from area to area (Table 5-17). The highest frequency of thatching was reported in the Panhandle area (north).

Table 5-17. Frequency with which dwellings are thatched (household survey data)

	North	West	South-west	South-east	Central	Average
% of dwellings that were thatched in the last year	19%	15%	9%	7%	14%	13%
Average interval between thatching (years)	5.2	6.7	11.6	14.6	7.4	7.8

A total of 65% and 53% of households in the north (Panhandle) and central (Delta) areas engaged in grass collecting over the past year, compared with 20 – 30% of households in the other areas. A total of some 174 000 bundles of grass are harvested from the study area annually. Of this an estimated 48% comes from the wetland. Wetland grass constitutes about 6% to 26% of grass collected in the SW, SE and central delta areas, but was over 60% of the grass harvested in the N and W areas. This is an unexpected result for the panhandle (N) area, since there is very limited floodplain in the area, and could be a function of interview technique (households were asked about wetland grasses first, and some may have responded about all grasses).

Grass harvesting is worth some P3 million in terms of net private value to households, averaging about 570 –1200 per household (Table 5-18), but generates very little in terms of cash income. The gross value added by grass is estimated to be P3.3 million.

Grass is used as an input into making brooms (as well as baskets, discussed under palms below). Some 14 000 brooms are produced per year, worth P117 000 to households, but not as a significant source of cash income (Table 5-19).

Table 5-18. Estimated household harvests and value of grass in the study area.

Grass		% hh	Produced (bundles)	Sold (bundles)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	65	150	8	8	1 212	1 175	74	1 273	1 256
	Total		91 847	6 253		1 277 959	1 233 735	97 058	1 341 857	1 321 137
W	Per user hh	31	60	7	18	1 074	1 037	124	1 128	1 111
	Total		21 220	2 359		371 350	358 775	41 593	389 917	384 090
SW	Per user hh	20	117	3	10	1 216	1 179	15	1 277	1 260
	Total		18 112	573		120 863	116 165	3 390	126 906	124 777
SE	Per user hh	21	33	1	18	587	569	22	616	608
	Total		41 876	762		1 366 288	1 341 187	20 705	1 434 603	1 423 157
C	Per user hh	53	39	1	20	764	692	26	802	769
	Total		828	41		41 731	37 898	1 854	43 818	42 063
	TOTAL(P, 2005)		173 883	9 988		3 178 191	3 087 761	164 600	3 337 101	3 295 225
	TOTAL (US$)			-		588 554	571 808	30 481	617 982	610 227

Table 5-19. Estimated household production of grass products in the study area.

Grass brooms		% hh	Produced (brooms)	Sold (brooms)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	9	2	0	10.0	21	20	3	22	22
	Total		668	95		6 681	6 340	954	7 015	6 913
W	Per producer hh	30	4	2	6.3	26	25	10	28	27
	Total		2538	939		16 076	15 423	5 948	16 880	16 684
SW	Per producer hh	2	2	0	8.0	12	11	-	13	12
	Total		39	0		313	285	-	329	320
SE	Per producer hh	11	15	12	8.8	130	129	108	136	136
	Total		10886	9083		95 256	94 469	79 477	100 019	99 783
C	Per producer hh	18	2	0	8.0	16.89	15	-	18	17
	Total		49	0		626	547	-	658	634
	TOTAL (P, 2005)		14 181	10 118		118 952	117 064	86 380	124 900	124 333
	TOTAL (US$)					22 028	21 678	15 996	23 130	23 025

5.4.4 Reeds and papyrus

Reeds *Phragmites australis* are a particularly important resource obtained from the delta. Reeds are used in construction of traditional houses, more so than in other areas because the soils tend to be sandy and thus generally unsuitable for construction.

Reed harvesting is most important in the panhandle area, where reeds are most accessible to households, and where about 69% of households harvested reeds in the last year. It is also common in the other areas apart from the South West, where most households are likely to be very far from reedbeds. In the South East (which includes Maun), larger quantities are harvested and more is sold. It is estimated that about 150 000 bundles of reeds are harvested annually from the delta (Table

5-20), contributing over P2.2 million to households. Apart from the SE, most of the harvest is for own use, and generates very little cash income.

Reed mats are used by a few households for sitting or for grain storage, and are produced mainly in the Panhandle area by a small percentage of households, generating a total value of about P7000 (Table 5-21). The production of reed fishing gear, mainly be households in the panhandle area, contributes a further net benefit of P3000 to households (Table 5-22). This probably includes the production of traditional Hambukushu fishing baskets from a reed-like grass.

Table 5-20. Estimated household harvests and value of reeds in the study area.

Reeds		% hh	Produced (bundles)	Sold (bundles)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	69	22	2	15.6	344	323	36	362	331
	Total		54 243	5727		843 778	791 722	89 079	885 966	810 180
W	Per user hh	33	20	3	20.0	392	371	57	411	381
	Total		13 427	1954		268 550	253 987	39 089	281 977	260 775
SW	Per user hh	7	28	0	15.9	443	422	-	465	434
	Total		2 543	0		40 430	38 490	-	42 451	39 627
SE	Per user hh	18	70	18	15.0	1 043	1 022	269	1 095	1 064
	Total		78 943	20370		1 184 147	1 160 020	305 554	1 243 354	1 208 228
C	Per user hh	22	13	0	15.9	200.92	180	-	211	180
	Total		452	0		9 106	8 143	-	9 561	8 159
	TOTAL (P, 2005)		149 608	28 051		2 346 010	2 252 361	433 723	2 463 311	2 326 969
	TOTAL (US$)					434 446	417 104	80 319	456 169	430 920

Table 5-21. Estimated household production and value of reed mats in the study area.

Reed mats		% hh	Produced (mats)	Sold (mats)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	5	2	1	20.0	44	43	20	46	46
	TOTAL (P, 2005)		350	159		6 999	6 776	3 181	7 349	7 290
	TOTAL (US$)	-	-	-	-	1 296	1 255	589	1 361	1 350

Table 5-22. Estimated household production and value of reed fishing gear in the study area.

Reed fish gear		% hh	Produced (traps or baskets)	Sold (traps or baskets)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	15	2	0	20.0	32	6	-	33	7
	Total		859	0		17 180	3 031	-	18 039	3 890
W	Per producer hh	2	2	0	20.0	30	5	-	32	7
	Total		76	0		1 523	269	-	1 599	345
	TOTAL (P, 2005)		935	-		18 703	3 300	-	19 638	4 235
	TOTAL (US$)		-			3 463	611	-	3 637	784

Reeds have been depleted in some areas, particularly where flooding no longer occurs in the lower delta, and are reportedly increasingly scarce (Kgathi et al. 2002). There is also pressure from some communities (e.g. Ditshiping – NG 32) to harvest reeds and grass in Moremi game reserve. The dwindling supply in relation to demand has led to premature harvesting of reeds and grasses. This demand is fuelled not only be construction needs but the possibility of generating cash income. Reeds and grasses are ideally harvested from the beginning July, after their seeds have matured.

However the traditional rules are not adhered to and the local conservation committees are ineffective (TLB 2006).

Papyrus *Cyperus papyrus* is found in the permanently inundated channels and pools of the delta, and is used mainly to make sleeping mats. Although this is one of the most abundant resources of the delta, it is not that accessible to households around the delta, apart from those living close to these permanently flooded areas. No papyrus is collected by households in the South West zone. Most papyrus collection is by households in the panhandle and central delta area, though this is still only by about 10% of households per year (Table 5-23). Almost none of this is for sale. Nearly all households that harvest papyrus also produce mats, worth about P100 – 125 apiece. This generates a total benefit to households of some P100 000, with about half of that being cash income to households.

Table 5-23. Estimated household harvests and value of papyrus in the study area.

Papyrus		% hh	Produced (bundles)	Sold (bundles)	Price	Gross private value	Net private value	Cash Income	Gross economic output
N	Per user hh	10	6	-	10	63	46	-	66
	Total	-	2 195	-	-	21 952	16 119	-	23 049
W	Per user hh	1	1	-	10	10	-7	-	11
	Total	-	25	-	-	254	-169	-	267
SE	Per user hh	1	1	-	10	10	-7	-	11
	Total	-	67	-	-	668	-445	-	701
C	Per user hh	12	8	-	10	80	47	-	84
	Total	-	17	-	-	1 978	1 154	-	2 077
	TOTAL (P, 2005)	-	2 304	-	-	24 851	16 658	-	26 094
	TOTAL (US$)	-	-	-	-	4 602	3 085	-	4 832

Table 5-24. Estimated household production and value of papyrus mats in the study area.

Papyrus mats		% hh	Produced (mats)	Sold (mats)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	9	2	1	114.0	228	227	101	239	239
	Total		636	283		72 536	72 089	32 238	76 163	76 045
W	Per producer hh	1	5	0	115.0	575	574	-	604	603
	Total		127	0		14 595	14 559	-	15 325	15 315
SE	Per producer hh	1	2	2	100	200	199	200	210	210
	Total		134	134		13 358	13 264	13 358	14 025	14 001
C	Per producer hh	16	1	0	125	172	170	31	180	180
	Total		3	1		5 665	5 619	1 030	5 948	5 936
	TOTAL (P, 2005)		900	417		106 154	105 531	46 626	111 461	111 297
	TOTAL (US$)		1 202	-		19 658	19 543	8 634	20 641	20 611

5.4.5 Palms

Leaves of the *Mokola* palm *Hyphaenae ventricosa* are harvested mainly for the manufacture of baskets, handbags and other crafts. This palm is typically associated with floodplains and fringes the myriad islands in the delta area. The young leaves are collected and dried before being used or packaged in very small bundles for sale. Dried leaves used in basketry are dyed using natural dyes such as from *Eucla divinorum* and *Berchemia discolour* (Terry 1984; Table 5-25). Baskets are made

by wrapping the palm leaves around grass *Eragrostis pallens* or vine (*Menispermancene*) to produce a coil (Terry 1984).

Basket making was introduced to the area by the Hambukushu, who had fled from Angola to Botswana in the 1960s and settled in the thirteen villages of Etsha, which is in the West area. They were not allowed to seek formal employment, but they were encouraged to practice basketry. Much effort has been made to support this activity, including marketing of the products by non-government organisations.

Table 5-25 Plants mentioned in focus group discussions that are used for dyeing baskets

Upland or wetland	Part	Species	Local price per unit	Availability	Trend
Wetland	Roots/bulb	Kgopane	P1 /tube about 10cm long	Scarce	Decreasing and also destroyed by elephants
Wetland	Bark	Motsintala	Pounded: P2/cup	Scarce	decreasing
Upland and wetland	Bark	Mothakula	P20 per bundle 10cm diameter and 20 cm long	Scarce	Decreasing
Upland	Bark	Mokolhe	Pounded: P2/cup	Scarce	Unknown

In this study, a fairly high proportion of households collected palm leaves, with almost none of this being for sale. Over 40% of households in the west and central areas collected palm leaves, the smallest involvement being in the SW area, as expected. Dried palm leaves fetch a reasonably high price, and the resource generates some P1.8 million for households (Table 5-26). The production of baskets and other palm products is high in the West and particularly in the South East area, with households in both these areas generating about P1500 in benefits per producer household (Table 5-27). A higher proportion of baskets were sold in the SE area (which includes Maun). Palm leaves and basketry together contribute a net private value of some P3.3 million.

Though focus group discussions indicated that this resource is plentiful, they did also note that it is decreasing in abundance. Indeed, it was already noted in the 1970s and 1980s that the supply of palm leaves around villages was becoming a problem due to overexploitation (Terrry 1984).

Table 5-26. Estimated household harvests and value of palm leaves in the study area. Note the price is for the equivalent of a harvesting bundle, not a selling bundle

Palm leaves		% hh	Produced (bundles)	Sold (bundles)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	12	3	0	570.0	1 754	1 753	5	1 841	1 841
	Total		1273	3		725 338	724 821	1 909	761 605	761 217
W	Per user hh	42	4	0	240.0	840	839	-	882	881
	Total		3021	0		724 932	723 854	-	761 179	760 370
SW	Per user hh	7	1	0	240.0	309	307	-	324	323
	Total		117	0		28 166	28 052	-	29 574	29 489
SE	Per user hh	29	2	0	65.2	156	155	2	164	163
	Total		4475	51		291 788	289 451	3 339	306 378	304 624
C	Per user hh	41	5	0	58.3	265.36	263	1.00	279	277
	Total		268	1		21 866	21 660	82	22 959	22 805
	TOTAL (P, 2005)		9 153	56		1 792 090	1 787 837	5 331	1 881 695	1 878 505
	TOTAL (US$)		4 688			331 869	331 081	987	348 462	347 871

Table 5-27. Estimated household production and value of palm products (mainly baskets) in the study area.

Palm products		% hh	Produced	Sold	Average Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	6.3	7	4	17	34	99	33	108	107
	Total		1 591	827		22 927	21 989	7 254	24 074	23 825
W	Per producer hh	9.9	49	39	31	506	1 514	1 187	1 595	1 594
	Total		10 026	7 843		308 389	307 533	240 975	323 808	323 582
SW	Per producer hh	1.1	10	-	41	137	407	-	432	430
	Total		130	-		5 359	5 304	-	5 627	5 613
SE	Per producer hh	11.5	34	32	53	530	1 587	1 482	1 671	1 669
	Total		24 912	23 175		1 168 887	1 165 791	1 088 897	1 227 332	1 226 513
C	Per producer hh	20.4	6	4	53	107	316	208	336	335
	Total		133	88		13 197	13 023	8 580	13 857	13 811
	TOTAL (P, 2005)		36 529	31 846		1 513 400	1 508 336	1 345 705	1 589 070	1 587 731
	TOTAL (US$)					280 259	279 321	249 205	294 272	294 024

5.4.6 Wild foods and medicines

Wild foods and medicines are harvested by the majority of households in the study area. Although this includes both rich and poor households, according to focus group discussions, poor households tend to harvest more. Women from all types of households tend to harvest fruits and leaves for food, whilst men tend to harvest the medicinal plants.

Some 23 of the more common wild food plants used in the study area are listed in Table 5-28 (based on focus group discussions). Only three of these come from the wetland, one of which (*Tswii* or water lily) is highly important. Focus groups differed in their perception of the contribution of wetland versus upland wild food plants, with estimates being in the range of 2-7%, apart from one group that claimed it was 85% (Gumare). The latter is highly implausible, however.

Use of wild foods various through the year, mainly due to the availability of these foods, rather than a particular period of household shortage of food or income. According to focus groups, fruits are mainly harvested during March – July and December – January (Figure 5-1). Wild vegetables tend to be harvested while they are available during December-January, during the rainy season (Figure 5-1). The availability of wild foods from year to year is also strongly dependent on rainfall (Table 5-28).

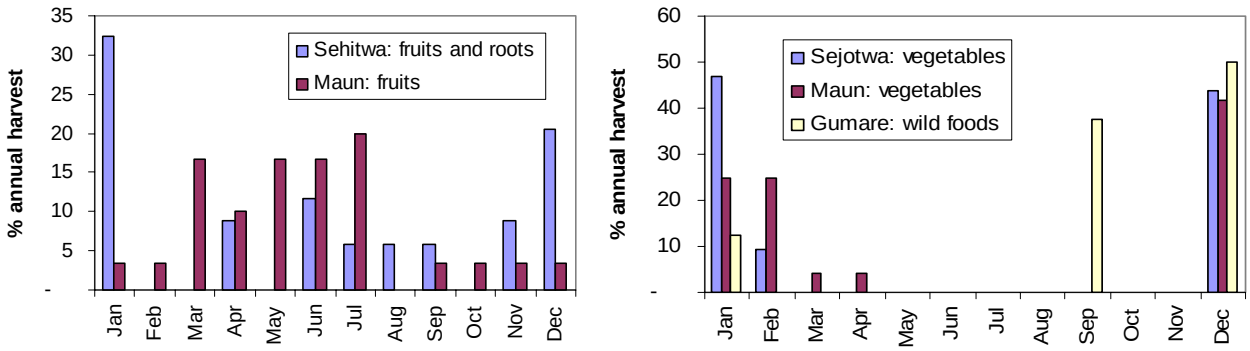

Figure 5-1 Relative use of wild foods over the year

Table 5-28 Details of food plants provided during focus group discussions

Upland or wetland	Part used	Species	Local price per unit	Availability	Trend
Wetland	Bulb	Tswii	P2- P5 Bulb or cooked	Scarce to enough; rainfall-dependent	Depends on rainfall
	Fruits	Moxinga	P1 - 2 per cup	Enough	Constant
		Mxumi	P.10/fruit		Constant- but elephants cattle and donkey destroy this tree.
Upland	Fruits	Motsentsila	P1.00 per cup	Scarce to enough; rainfall-dependent	Decreasing due to veld fires and low rains
		Mmupudu			
		Moretologa			
		Mokgomphate			
		Motetlwa			
		Motsaudi			
		Mochaba			
		Mokuchumo			
		Motopi			
		Mogwana		Enough	Decreasing
		Mokgalo			
		Mutsanga			
		Murama			
		Leketa	P1-2 per cup (dried)	Scarce to enough; rainfall-dependent	Decreasing, have to travel far to get it
	Leaves	Thepe	Dried P1/cup	Enough	Decreasing, have to travel far to get it
		Delele	P1 per cup (dried)		
		Dikouyama	Not sold		Decreasing
	Roots	Legonyana	Not sold	Enough	Decreasing
		Monoga			
		Mosvegapoo			
	Roots				

A few of the medicinal plants harvested by ordinary households are listed in Table 5-29. It should be noted that the list harvested by traditional healers would be much longer, but a detailed study of medicinal plant use was beyond the scope of this study. One of the six medicinal plants mentioned was a wetland species, the remainder being obtained in the uplands. It was difficult to obtain a reasonable assessment of value and availability in these groups.

Table 5-29 Details of medicinal plants provided during focus group discussions

Upland or wetland	Part used	Species	Local price per unit	Availability	Trend
Wetland	Root	Mbodzi	Not sold	Enough	Decreasing
Upland	Root	Mophane			
		Mogonono			
		Sitsi			
		Devils Claw	Not sold	Enough	Decreasing
	Fruit	Thulathulani			

The results of this study suggest that 53 – 65% of households in the study area harvested wild foods in the past year. Not all households provided data on the amount of use, however. Based on the data obtained, it is estimated that at least 75 tons of wild foods are harvested from the wetland per year, with less than 20% of this being traded (Table 5-30). This yields a net private value of just under P100 000 to households, though the value is very small at a household level (Table 5-30). In comparison, over 200 tons are harvested from the uplands, with a similar proportion being sold (Table 5-31). Upland foods are worth some P1.3 million to households. Thus wetland foods contribute about 7% of the value of wild foods.

Table 5-30. Estimated household harvests and value of wetland foods in the study area.

Wetland foods		% hh	Harvested (kg)	Sold	Average Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	57	22	6	1	29	29	6	30	30
	Total		44 651	12 248	-	57 178	57 178	12 248	60 037	60 037
W	Per user hh	53	17	1	1	21	21	2	22	22
	Total		18 301	1 345	-	22 917	22 917	1 974	24 063	24 063
SW	Per user hh	64	No data							
	Total									
SE	Per user hh	57	3	-	1	5	5	-	5	5
	Total		10 719	-	-	16 755	16 755	-	17 593	17 593
C	Per user hh	65	13	-	1	18	18	-	19	19
	Total		1 487	-	-	2 357	2 357	-	2 475	2 475
	TOTAL (P, 2005)		75 159	13 594		99 207	99 207	14 222	104 168	104 168
	TOTAL (US$)					18 372	18 372	2 634	19 290	19 290

Relatively few households harvested medicines, probably based primarily on household needs. Indeed, most of the harvest is for own use, with only about 23% being sold. Medicinal plants are worth in the order of P280 000 to households in the study area (Table 5-32). The contribution by wetlands was not established and is expected to be smaller than for foods.

Table 5-31. Estimated household harvests and value of upland foods in the study area.

Upland foods		% hh	Harvested (kg)	Sold	Average Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	57	33	1	5	190	190	2	200	200
	Total		65 357	1 273	-	381 674	381 674	4 136	400 758	400 758
W	Per user hh	53	25	4	3	67	67	14	71	71
	Total		27 223	4 848	-	73 445	73 445	15 524	77 117	77 117
SW	Per user hh	64	21	1	4	89	89	4	94	94
	Total		16 769	848	-	69 906	69 906	2 983	73 401	73 401
SE	Per user hh	57	25	8	7	204	204	47	214	214
	Total		92 651	29 587	-	748 298	748 298	172 429	785 713	785 713
C	Per user hh	65	48	-	5	247	247	-	259	259
	Total		5 559	-	-	32 560	32 560	-	34 188	34 188
	TOTAL (P, 2005)		207 560	36 555		1 305 883	1 305 883	195 072	1 371 177	1 371 177
	TOTAL (US$)					241 830	241 830	36 124	253 922	253 922

Table 5-32. Estimated household harvests and value of medicinal plants in the study area

Medicinal plants		% hh	Harvested (kg)	Sold (kg)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	11.7	18.8	10.1	70.0	231.0	229.1	103.1	242.6	240.6
	Total		7 764.2	4 167.6	-	95 537.4	94 749.6	42 630.7	100 314.3	99 487.1
W	Per user hh	12.3	17.8	1.3	70.0	326.5	324.6	50.0	342.8	340.8
	Total		4 518.1	317.3	-	82 874.8	82 391.3	12 691.4	87 018.5	86 510.9
SW	Per user hh	19.1	7.8	-	70.0	99.5	95.7	-	104.5	100.5
	Total		1 823.6	-	-	23 360.7	22 466.5	-	24 528.7	23 589.8
SE	Per user hh	15.6	5.2	-	70.0	79.4	77.5	-	83.3	81.3
	Total		5 246.2	-	-	79 510.8	77 602.6	-	83 486.4	81 482.7
C	Per user hh	10.2	2.9	-	70.0	29.0	25.2	-	30.5	26.5
	Total		91.6	-	-	598.2	519.8	-	628.2	545.8
	TOTAL (P, 2005)		19 443.7	4 484.9		281 881.9	277 729.8	55 322.1	295 976.0	291 616.3
	TOTAL (US$)					52 200.4	51 431.4	10 244.8	54 810.4	54 003.0

Many households in the study area use the fruits harvested together with sorghum to brew Kgadi beer (Table 5-33). Those households that do produce beer do so on a regular basis and produce fairly large quantities. This is a very important cash-generating activity, and over 90% of the beer produced is sold. Producer households may earn over P2500 per year from this activity, with a total value of P2.4 million to households in the study area (Table 5-33).

Table 5-33. Estimated household production and value of fruit-based beverages in the study area

Fruit-based drinks		% hh	Produced (litres)	Sold (litres)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	16	1 206	993	1	1 582	1 582	1 302	1 661	1 661
	Total		690 713	568 405	-	906 053	906 053	745 613	951 356	951 356
W	Per producer hh	9	36	26	2	78	78	55	82	82
	Total		6 447	4 569	-	13 815	13 815	9 791	14 506	14 506
SW	Per producer hh	21	625	594	1	910	910	864	955	955
	Total		162 931	154 794	-	237 279	237 279	225 430	249 143	249 143
SE	Per producer hh	7	1 536	1 531	2	2 645	2 645	2 635	2 777	2 777
	Total		718 302	715 631	-	1 236 677	1 236 677	1 232 078	1 298 511	1 298 511
C	Per producer hh	12	414	414	1	518	518	518	544	544
	Total		6 097	6 097	-	12 798	12 798	12 798	13 438	13 438
	TOTAL (P, 2005)		1 584 491	1 449 496		2 406 624	2 406 624	2 225 709	2 526 955	2 526 955
	TOTAL (US$)					445 671	445 671	412 168	467 955	467 955

5.4.7 Woody resources

Woody resources in the study area are used for fuel, building materials, fencing material and wooden canoes. Most households are reliant on fuel wood for cooking and harvest fuel wood on a regular basis. The reliance is almost 100% in the more remote south-west and central areas, and slightly lower in the other areas where there is significant urbanisation. It is estimated that almost 1.8 million bundles are harvested per annum, of which less than 10% is traded (Table 5-34). The total harvest is worth some P8.6 million to households in the study area, translating to between P400 and P1000 per household per year. *Mogothlo* and *Mogonono* are the most important species for firewood, and focus groups did not perceive any problem with availability of this resource (Table 5-35).

Table 5-34. Estimated household harvests and value of fuel wood in the study area

Firewood		% hh	Produced (bundles)	Sold (bundles)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	77	116	5	5	582	561	26	611	580
	Total		318 617	14 444		1 593 085	1 534 945	72 218	1 672 739	1 588 094
W	Per user hh	86	209	43	5	1 043	1 022	215	1 096	1 065
	Total		370 792	76 402		1 853 959	1 816 202	382 011	1 946 657	1 891 687
SW	Per user hh	98	110	9	5	552	531	44	580	549
	Total		132 510	10 562		662 548	637 055	52 811	695 675	658 561
SE	Per user hh	85	169	10	5	845	824	51	887	857
	Total		925 745	56 102		4 628 726	4 512 348	280 509	4 860 162	4 690 730
C	Per user hh	96	87	-	5	437	416	-	459	428
	Total		15 065	-		84 586	80 471	-	88 815	82 824
	TOTAL (P, 2005)		1 762 729	157 510		8 822 904	8 581 022	787 548	9 264 049	8 911 897
	TOTAL (US$)					1 633 871	1 589 078	145 842	1 715 565	1 650 351

Table 5-35 Main species used for fuelwood according to focus group discussions

Species	**% contribution**		**Availability**	**Trend**
	Gumare	**Sehitwa**		
Mogotlho	80	22%	plenty	constant
Mogonono	9	66%	plenty	constant
Mosu (Acacia)	8	12%	plenty	constant
Mudubane	3		scarce	decreasing

A fairly large proportion of households collect poles and withies (thin poles) for house and fence construction. It is estimated that at least 276 000 poles were collected in the last year, worth some P1.7 million to households, or about P200 – 900 per user household. Very little cash income is generated from this activity (Table 5-36).

Table 5-36. Estimated household harvests and value of poles in the study area

Poles+withies		% hh	Produced (poles)	Sold (poles)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	49	47	2	12	290	265	10	304	270
	Total	-	80 585	3 881	-	497 577	455 651	17 571	522 456	464 260
W	Per user hh	28	66	1	12	447	423	6	470	436
	Total	-	38 379	508	-	261 087	246 840	3 414	274 142	254 365
SW	Per user hh	34	139	0	12	968	943	1	1 017	982
	Total	-	58 196	78	-	403 972	393 391	344	424 170	409 618
SE	Per user hh	28	54	-	12	339	315	-	356	323
	Total	-	97 109	-	-	612 170	568 162	-	642 778	581 693
C	Per user hh	47	34	-	12	207	181	-	217	182
	Total	-	1 908	-	-	19 582	17 179	-	20 561	17 256
	TOTAL (P, 2005)	-	276 178	4 467	-	1 794 388	1 681 222	21 329	1 884 108	1 727 193
	TOTAL (US$)	-	-	-	-	332 294	311 337	3 950	348 909	319 850

Almost no households claimed to have harvested any timber in the past year, with the total estimated harvest amounting to some 2300 trees. This is a relatively valuable activity, however, in that it generates considerable income to user households of up to P12 000 per year, and a total value of some P570 000 to households. It is possible that this survey did not capture some of the more commercial timber producers.

Table 5-37. Estimated household harvests and value of timber in the study area

Timber		% hh	Produced (logs)	Sold (logs)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	1	50	20	245	12 250	12 223	4 900	12 863	12 827
	Total	-	1 591	636	-	389 721	388 872	155 889	409 207	408 084
W	Per user hh	1	3	3	245	735	708	735	772	736
	Total	-	76	76	-	18 656	17 979	18 656	19 589	18 693
SW	Per user hh	-	-	-						
	Total	-	-	-						
SW	Per user hh	1	10	-	245	2 450	2 423	-	2 573	2 537
	Total	-	668	-	-	163 630	161 847	-	171 812	169 453
C	Per user hh	-	10	-	245	2 450	2 423	-	2 573	2 537
	Total	-	21	-	-	-	-	-	-	-
	TOTAL (P, 2005)	-	2 356	712	-	572 008	568 697	174 545	600 608	596 230
	TOTAL (US$)	-	-	-	-	105 927	105 314	32 323	111 224	110 413

A great deal more households (10 – 22%) claimed to make various wood products from timber, however. Households manufacture furniture items, various items used in production such as hoe handles and yokes, as well as items such as musical instruments (Table 5-38).

Table 5-38 Relative proportion of different types of products made from timber in the study area.

Type	% of all products	Type	% of all products
Axe/hoe handles	29%	Window frames	4%
Yokes	18%	Sleighs	2%
Tables	11%	Milking pots	2%
Doors	10%	Musical instruments	2%
Chairs	9%	Paddles	1%
Pounding pots & sticks	7%	Stools	1%
Ladles	5%		

Most production is for sale, and in this case the sales over the last year exceeded production! It is possible that some of these sales were of second-hand goods. The production of wood items thus yields a total value of at least P190 000 to households (Table 5-39).

Table 5-39. Estimated household production and value of wood products in the study area

Wood products		% hh	Produced	Sold	Average Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per producer hh	20	5	10	53	237	202	268	249	222
	Total	-	3 722	6 776	-	165 904	141 524	187 828	174 199	155 251
W	Per producer hh	22	2	1	44	61	31	38	64	41
	Total	-	939	660	-	27 870	14 332	17 485	29 264	18 808
SW	Per producer hh	13	3	5	85	275	246	317	289	266
	Total	-	430	769	-	43 067	38 430	49 611	45 220	41 639
SE	Per producer hh	20	1	1	57	32	-3	10	33	6
	Total	-	1 132	735	-	40 363	-3 839	12 677	42 382	8 029
C	Per producer hh	10	1	0	55	30	6	6	31	12
	Total	-	48	8	-	618	122	114	648	253
	TOTAL (P, 2005)	-	6 272	8 948	-	277 822	190 569	267 715	291 713	223 981
	TOTAL (US$)	-	-	-	-	51 448	35 291	49 577	54 021	41 478

5.4.8 Fish

The Okavango Delta supports the largest fishery in Botswana (Mmopelwa *et al*. 2005). It is believed to have been fished for centuries. Traditional fishing gear (hook and line, baskets, spears and traps) is still widely used in the delta (Mmopelwa *et al*. 2005), but modern gear (gill nets and powered boats) was introduced in the 1980s through the provision of government grants and credit schemes. Several projects were implemented in the 1980s to train fishers to use modern gear, and to help them form groups or syndicates to finance fishing operations (mainly under the Financial Assistance Program (FAP). More recently, FAP projects have concentrated on fish marketing in the region. Twenty years on, much of the gear has degraded or broken down altogether, with little or no reinvestment, and many have left the fishery (focus group discussions). Little is known of the value of the fishery (Mmopelwa *et al*. 2005).

Mosepele (2001, in Mosepele 2005), estimated there to be about 3243 fishers in the delta, divided as follows:

- Hook & line fishers: 46%
- Basket fishers 42%
- Gillnet fishers 14%
- Spear fishers 9% and
- Trap fishers 6% (Mosepele 2005).

Gillnet fishers may be subsistence or commercial fishers, the latter being characterised by higher fishing effort (>200 settings per annum) and more modern equipment (such as boats and freezers). These constituted about 41 of the estimated 241 gillnet fishers (Mosepele 2005). In reality there is a continuum between these two categories, and in this study we did not distinguish between subsistence and commercial gillnet fishers.

It should also be noted that estimates of the number of fishers in the delta range widely, from 700 to 12 000. Part of the reason for this undoubtedly lies in the definition of a fisher, which may vary from occasional to seasonal or professional (Norfico 1986). Fishing effort varies seasonally as well as interannually, with more fishers purportedly fishing in higher flood years (Mosepele 2005). In this study a fisher is defined as anyone who has fished in the past year.

In this study, we estimated the total number of fishers to be 3574 (Table 5-40), which is similar to Mosepele's estimate given above. 61% of these considered themselves modern fishers as opposed to traditional fishers, and all of these belonged to households that had one or more gillnets. Thus the proportion of gillnet fishers estimated in this study is far higher than in Mosepele's (op cit) study.

Table 5-40 Estimated number of fishers in the study area based on this study

		North	West	South-west	South-east	Central	TOTAL	
Traditional	Men	318	25	0	0	0	344	1387
	Women	700	127	0	0	0	827	
	Child	191	0	26	0	0	217	
Modern (gillnet)	Men	923	51	26	334	58	1391	2186
	Women	255	0	13	67	12	347	
	Children	223	25	0	200	0	448	
Total		**2609**	**228**	**65**	**601**	**70**	**3574**	

While fishing takes place throughout the delta, the upper delta is hydrologically more stable, supports a higher abundance and diversity of fish, and the highest density of fishers (Mosepele 2005). Moreover, there are relatively few opportunities for fishing in the lower delta, because fishing is banned in Moremi Game Reserves, and in many private tourism concession areas. Most of the FAP funded fishing projects have taken place in the western Okavango.

The main targeted species are three-spot tilapia *Oreochromis andersonii*, green-head tilapia *O. macrochir*, large-mouth speckle-face tilapia *Serranochromis angusticeps*, red-breast tilapia *Tilapia rendalli*, sharp-tooth catfish *Clarias gariepinus*, blunt-tooth catfish *C. ngamensis* and tigerfish *Hydrocynus vittatus* (Mosepele 2005). Demand for catfish and tigerfish is low because of religious and cultural taboos. Bream species (tilapia) are thus the main exploited species and make up most of the catch weight. Sliver catfish *Schilbe intermedius*, squeakers *Synodontis* spp and other small species comprise a large proportion of the fish biomass in the system, but catches of these are very low (Merron & Bruton 1988, 1995).

The catch composition of the gillnet fishery resembles that of findings of Mosepele (2005) for the period 1996 – 2002, with bream dominating, followed closely by catfish, except in 2001/2 when catches of catfish were very low. The main difference is that the estimates of total catch for the gillnet fishery are far higher. In this study, the estimated catch is about 323 tons in the modern fishery and a further 130 tons in the traditional fishery (Table 5-41). Mosepele (2005) recorded a fairly constant catch of bream of about 80 tons, and the estimated total catch of this fishery is generally under 200 tons based on recorded landings. The difference is to be expected because of the discrepancy in the number of players in the fishery. Indeed, earlier estimates of the total fishery range up to 1200 tons, much larger than the estimated total catch of 450 tons obtained in this study. Murray (2005) estimated a total annual catch of 295 tons, based on data from Mosepele (2001). While much of the focus is on the gillnet fishery, this study suggests that the traditional fishers are responsible for a large proportion of the total catch.

Table 5-41 Estimated total catches of different types of fish in the traditional and modern fishery (this study)

	Traditional	**Modern (gillnet)**	**Total**
Catfish	58.7	125.0	183.8
Bream	20.3	135.9	156.2
Silver catfish	29.9	26.4	56.4
Tigerfish	11.6	32.5	44.1
Other	9.0	3.3	12.3
Total	**129.5**	**323.2**	**452.7**

The traditional fishery is centred mainly in the panhandle region, and to some extent the west. Total value of this fishery is estimated to be about P660 000 to households, with just over 10% of this being realised as cash income (Table 5-42). The gillnet fishery is particularly important in the panhandle and delta areas, where about 20% of households are engaged in fishing. Households derive a total value of about P2 million, with about 65% of this value being realised as cash income (Table 5-33). Note that these values would be expected to fluctuate markedly as effort and productivity changes between different rainfall years.

Table 5-42. Estimated household production and value of the traditional fishery

Traditional fishing		% hh	Produced (kg)	Sold (kg)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per fishing hh	15	227	23	6	1 282	1 165	131	1 346	1 341
	Total	-	122 998	12 536	-	693 317	630 268	70 661	727 983	725 146
W	Per fishing hh	5	63	-	5	320	273	-	336	334
	Total	-	6 350	-	-	32 448	27 727	-	34 070	33 918
SW	Per fishing hh	1	10	-	3	24	4	-	25	24
	Total	-	125	-	-	313	53	-	329	310
SE	Per fishing hh	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-
C	Per fishing hh	2	-	-	-	-	-40	-	-	-6
	Total	-	-	-	-	-	-165	-	-	-25
	TOTAL (P, 2005)	-	129 473	12 536	-	726 079	657 883	70 661	762 382	759 349
	TOTAL (US$)	-	-	-	-	134 459	121 830	13 085	141 182	140 620

Table 5-43. Estimated household production and value of the gillnet fishery (subsistence and commercial)

Gillnet fishing		% hh	Produced (kg)	Sold (kg)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per fishing hh	19	360	228	7	2 593	2 430	1 646	2 722	2 708
	Total	-	240 238	152 523	-	1 732 044	1 623 443	1 099 644	1 818 646	1 808 905
W	Per fishing hh	2	10	-	7	69	-137	-	72	71
	Total	-	522	-	-	3 499	-6 961	-	3 674	3 598
SW	Per fishing hh	3	47	8	7	343	271	58	360	358
	Total	-	1 836	312	-	13 423	10 587	2 282	14 095	13 993
SE	Per fishing hh	11	88	40	7	600	359	272	630	601
	Total	-	64 366	29 238	-	440 687	263 441	200 184	462 721	441 232
C	Per fishing hh	20	394	25	8	3 062	2 843	194	3 215	3 187
	Total	-	16 226	1 027	-	126 149	117 128	7 982	132 457	131 325
	TOTAL (P, 2005)	-	323 188	183 100	-	2 315 803	2 007 637	1 310 092	2 431 593	2 399 054
	TOTAL (US$)	-		-	-	428 852	371 785	242 610	450 295	444 269

The sustainability of the fishery is unknown, although fishers perceive that the fish stocks are still in abundance (Kgathi et al. 2002). While fisheries were formerly governed under traditional law of the Bayei and Hambukushu people, with villages having exclusive fishing rights to designated areas (Campbell 1976, Tlou 1985), the fishery is effectively unregulated today, with neither regulation nor a national fisheries policy (Mosepele 2005). The fishery is consequently an open access one, leading to concerns about the sustainability of the commercial fishery in particular. The recreational fishers report declining stocks which they blame on the commercial (gillnet) fishing. However a number of other factors may have played a role, including drought in the 1980s, spraying against tsetse fly, and burning or other ecological factors (Merron 1993, Merron & Bruton 1988, Skelton *et al*. 1985). Indeed fishers argue that catches are correlated to the extent of flooding (Ramberg & van der Waal 1997), a fact which is consistent with findings in many large wetland systems (Welcomme 1992, Kolding 1994).

The fishery is relatively small in relation to the size of the delta. One reason is that the delta may be comparably less productive than other systems because of its nutrient poor status. Another contributing factor is undoubtedly the relative wealth of the inhabitants compared to other countries. Fishing is usually one of a variety of household activities that reduces risk and provides a social safety net. Thus it is to be expected that fishing activity would be lower in wealthier areas.

There is considerable friction between fishers and tour operators in the delta. Fishers argue that tourist operators, particularly within the WMAs, claim exclusive fishing rights within their concessions, but the law and policy regarding this issue is ambiguous (Mosepele 2005). Tourism operators wish to exclude fishers in order to maintain a pristine environment. There are also conflicts between recreation and subsistence/commercial fishing, and even between subsistence and commercial fishers (Mosepele 2005). While the conflict rages mostly in the panhandle area, both subsistence and commercial fishing are strictly prohibited within concessions in the lower delta.

5.4.9 Honey

A very small proportion of households collect wild honey in the study area, with an estimated total production of only 421 litres per year. This resource is valued at about P1000 overall, and it thus not particularly significant.

Table 5-44. Estimated household harvest and value of wild honey

Honey		% hh	Produced (litres)	Sold (litres)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per user hh	2	3	-	3	10	9	-	10	9
	Total	-	207	-	-	620	560	-	651	588
W	Per user hh	1	5	-	3	15	14	-	16	15
	Total	-	127	-	-	381	357	-	400	374
SW	Per user hh	1	0	-	3	1	-0	-	1	-0
	Total	-	3	-	-	10	-3	-	10	-3
SE	Per user hh	2	1	-	3	2	1	-	2	1
	Total	-	80	-	-	240	113	-	252	119
C	Per user hh	2	1	-	3	3	1	-	3	1
	Total	-	4	-	-	12	5	-	13	5
	TOTAL (P, 2005)	-	421	-	-	1 264	1 031	-	1 327	1 083
	TOTAL (US$)	-	-	-	-	234	191	-	246	201

5.4.10 Wild animals and birds

Hunting is a traditional activity that has been performed by inhabitants of the study area for centuries. Traditionally, people have migrated into the inner parts of the delta during the dry season when animals were concentrated around the water, and moved away to upland areas during the rainy season when wildlife fruits were available everywhere. Hunting activity was concentrated in the dry season. Now hunting is supposed to be carried out under licence, based on citizen hunting quotas. The regulation of hunting stripped many rural inhabitants of their special game licences and what most of the population considered to be their birthright (Boggs 2006). Hunting restrictions affected both the spiritual aspect of residents and other related socioeconomic and cultural traditions such as acquisition of skin clothing (Mbaiwa 2005). Restrictions on hunting and the establishment of permanent settlements changes this lifestyle, changing to crop farming, but this is still not very feasible due to crop damage and predation by wild animals (Mbaiwa 2005). Many resorted to hunting illegally to sustain their livelihoods. This was reiterated both in focus group discussions and in discussions with tourism operators.

In this study we estimate that some 36 – 61% of households in the different areas have members who engage in hunting. This is somewhat lower than the estimated 85% of households in the nearby region around Lake Liambezi (Turpie & Egoh 2003). Based on limited household data, the total catch is estimated to be in the order of 100 tons per annum, worth some P125 000 to households. Hunting was dominated by small animals such as hare, spring hare, porcupines and small antelope.

Table 5-45. Estimated household harvest and value of wild animals

Wild animals		% hh	Produced (kg)	Sold (kg)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per hunting hh	36	73	-	4	256	214	-	268	147
	Total	-	92 897	-	-	325 139	272 646	-	341 396	187 496
W	Per hunting hh	49	6	-	4	21	-20	-	22	-99
	Total	-	6 092	-	-	21 322	-20 560	-	22 388	-100 402
SW	Per hunting hh	43	3	-	4	11	-31	-	11	-110
	Total	-	1 565	-	-	5 477	-16 039	-	5 751	-57 329
SE	Per hunting hh	42	0.6	-	3.5	2.2	-39.1	-	2.3	-118.6
	Total	-	1 687	-	-	5 905	-105 454	-	6 201	-320 286
C	Per hunting hh	61	-	-	4	-	-41	-	-	-121
	Total	-	-	-	-	-	-5 099	-	-	-14 948
	TOTAL (P, 2005)	-	102 241	-	-	357 843	125 494	-	375 735	-305 469
	TOTAL (US$)	-	-	-	-	66 267	23 240	-	69 580	-56 568

Households also hunt birds, both in the uplands (mainly partridge) and wetlands (ducks and other waterfowl). Some 60 000 birds are estimated to be hunted per year, of which about 12 000 are wetland birds. Upland and wetland birds contribute about P430 000 in terms of net private value to households (Table 5-46).

Table 5-46. Estimated household harvest and value of birds

Birds		% hh	Produced (birds)	Sold (birds)	Price	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
N	Per hunting hh	36	10	-	29	145	65	-	152	-88
	Total	-	12 726	-	-	183 885	82 080	-	193 079	-112 335
W	Per hunting hh	49	25	5	29	354	274	72	372	132
	Total	-	24 875	5 077	-	359 446	278 221	73 356	377 418	133 743
SW	Per hunting hh	43	21	-	29	300	220	-	315	75
	Total	-	10 823	-	-	156 392	114 665	-	164 211	39 030
SE	Per hunting hh	42	4	-	29	54	-26	-	57	-183
	Total	-	10 124	-	-	146 286	-69 684	-	153 601	-494 311
C	Per hunting hh	61	17	5	29	241	201	72	253	133
	Total	-	1 417	425	-	29 768	24 824	8 930	31 256	16 424
	TOTAL (P, 2005)	-	59 964	5 502	-	875 776	430 105	82 287	919 565	-417 449

5.5 Total direct use value derived from household use activities

Table 5-51 shows the private and economic values associated with household agricultural activities in the Ramsar site and the wetland. Net private values amounting to P68 million are generated from the Ramsar site but only P2.2 million of these are attributable to the wetland itself. Most of the values generated are from livestock. The contribution of agricultural activities in the Ramsar site to the gross national product amounts to P43 million. P1.5 million of these are derived from the wetland.

Table 5-47 Summary of the private and economic direct use values for agricultural activities in the Ramsar site and the wetland (Pula, 2005)

	Gross private value	Net private value	Cash income	Gross output	Gross value added
Ramsar Site					
Crops - Molapo	2,633,828	2,191,651	225,542	**2,765,519**	**1,368,763**
Crops - Dryland	5,996,164	4,197,849	835,751	**6,265,469**	**1,399,770**
Total crops	**8,629,992**	**6,389,500**	**1,061,293**	**9,030,989**	**2,768,533**
Livestock - Cattle posts	71,005,101	54,543,748	40,818,484	**74,555,356**	**34,365,674**
Livestock - Village	8,241,681	6,622,083	2,788,007	**8,653,765**	**5,391,954**
Livestock total	**79,246,782**	**61,165,831**	**43,606,492**	**83,209,121**	**39,757,628**
Total Ramsar Site	**87,876,774**	**67,555,331**	**44,667,784**	**92,240,110**	**42,526,161**
Wetland					
Crops - Molapo	1,132,546	942,410	96,983	**1,189,173**	**588,568**
Crops - Dryland	-	-	-	**-**	**-**
Total crops	**1,132,546**	**942,410**	**96,983**	1,189,173	**588,568**
Livestock - Cattle posts	-	-	-	**-**	**-**
Livestock - Village	1,604,947	1,205,482	391,050	**1,685,195**	**869,980**
Livestock total	**1,604,947**	**1,205,482**	**391,050**	**1,685,195**	**869,980**
Total Wetland	**2,737,493**	**2,147,892**	**488,033**	**2,874,368**	**1,458,548**

The direct private and economic direct use values derived from use of natural resources in the Ramsar site are summarised in Table 5-48. In total households derive a net private value of about P27 million from natural resources harvesting and processing in the study area. These activities contribute P28 million in gross value added to the gross national product.

Table 5-48 Summary of the total direct use values derived from natural resources use in the study area (Pula, 2005)

Aggregate values (Pula)	Gross private value	Net private value	Cash Income	Gross economic output	Gross value added
Clay pots	151 416	149 492	-	158 987	157 833
Upland grass	1 636 657	1 600 496	45 406	1 718 489	1 702 171
Wetland grass	1 541 534	1 487 264	119 193	1 618 611	1 593 054
Grass brooms	118 952	117 064	86 380	124 900	124 333
Reeds	2 346 010	2 252 361	433 723	2 463 311	2 326 969
Reed mats	6 999	6 776	3 181	7 349	7 290
Reed fish gear	18 703	3 300	-	19 638	4 235
Papyrus	24 851	16 658	-	26 094	22 407
Papyrus mats	106 154	105 531	46 626	111 461	111 297
Palm leaves	1 792 090	1 787 837	5 331	1 881 695	1 878 505
Palm products	1 513 400	1 508 336	1 345 705	1 589 070	1 587 731
Wetland veg	43 579	43 579	12 756	45 758	45 758
Wetland fruits	55 628	55 628	1 466	58 409	58 409
Upland veg	1 084 129	1 084 129	117 700	1 138 335	1 138 335
Upland fruits	221 755	221 755	77 372	232 842	232 842
Fruit-based drinks	2 406 624	2 406 624	2 225 709	2 526 955	2 526 955
Medicinal plants	281 882	277 730	55 322	295 976	291 616
Firewood	8 822 904	8 581 022	787 548	9 264 049	8 911 897
Poles & withies	1 794 388	1 681 222	21 329	1 884 108	1 727 193
Timber	572 008	568 697	174 545	600 608	596 230
Wood products	277 822	190 569	267 715	291 713	223 981
Traditional fishing	726 079	657 883	70 661	762 382	759 349
Modern fishing	2 315 803	2 007 637	1 310 092	2 431 593	2 399 054
Honey	1 264	1 031	-	1 327	1 083
Wild animals	357 843	125 494	-	375 735	-305 469
Upland birds	707 014	481 706	23 602	742 364	66 441
Wetland birds	168 763	-51 601	58 685	177 201	-483 890
Total Upland	**18 434 658**	**17 487 031**	**3 882 628**	**19 356 388**	**17 395 441**
Total Wetland	**10 659 593**	**9 881 189**	**3 407 419**	**11 192 572**	**10 310 168**
TOTAL	**29 094 247**	**27 368 220**	**7 290 048**	**30 548 960**	**27 705 608**

5.6 The contribution of delta resources to household livelihoods

The findings of this study corroborate largely with Rashem's description of household livelihoods, with livestock providing by far the most important contribution to total and cash income. However, this does not correspond well to the perception of relative value of the households themselves (Figure 5-2, Table 5-49). Households generally perceived the value of livestock to be slightly greater than that of crops, whereas the estimated value of livestock was far greater than that of crops. It may also be that the perception of the value of crops is overstated because of their fundamental importance in providing a means of survival. In reality, most farming is purely for subsistence purposes, yields are low and only about 10% of farmers are able to meet their household food needs (Bendsen & Meyer 2002). Natural resources make up from over half to less than a quarter of the income derived from agriculture plus natural resource use (Figure 5-2).

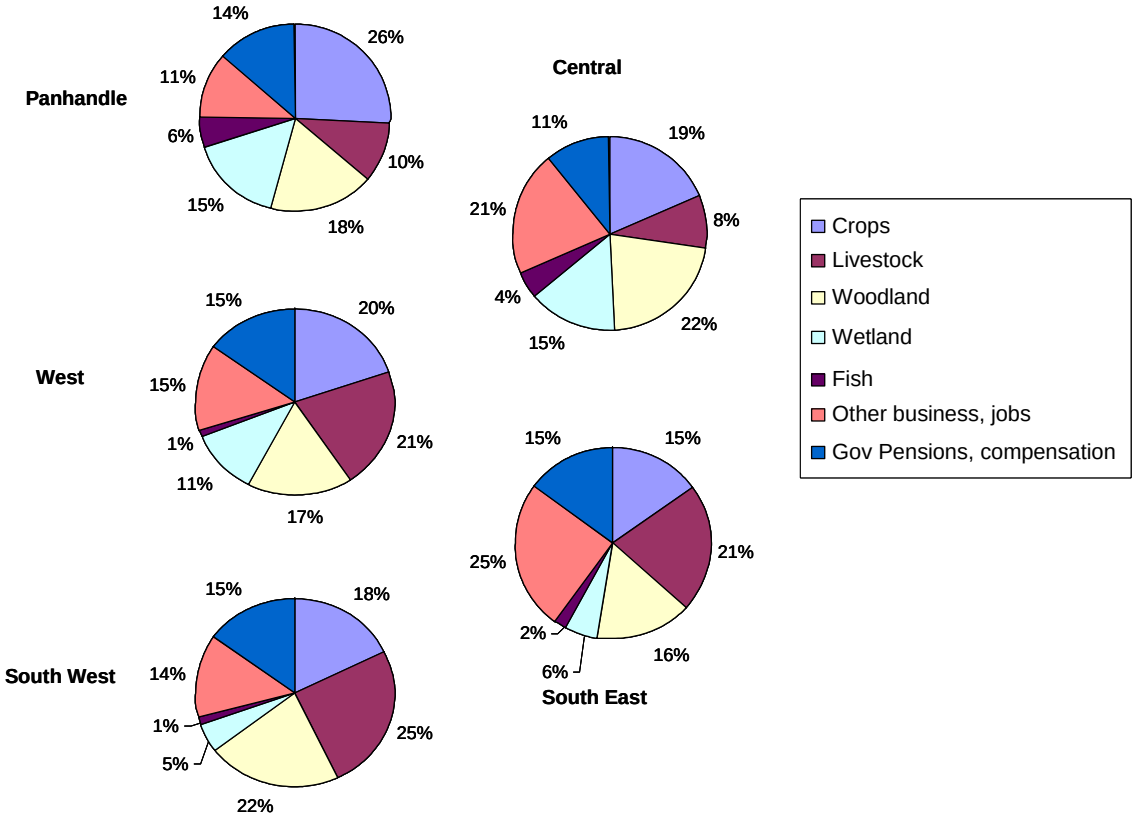

Figure 5-2 Average household perception of the relative value of different sources of household livelihoods in the five different zones.

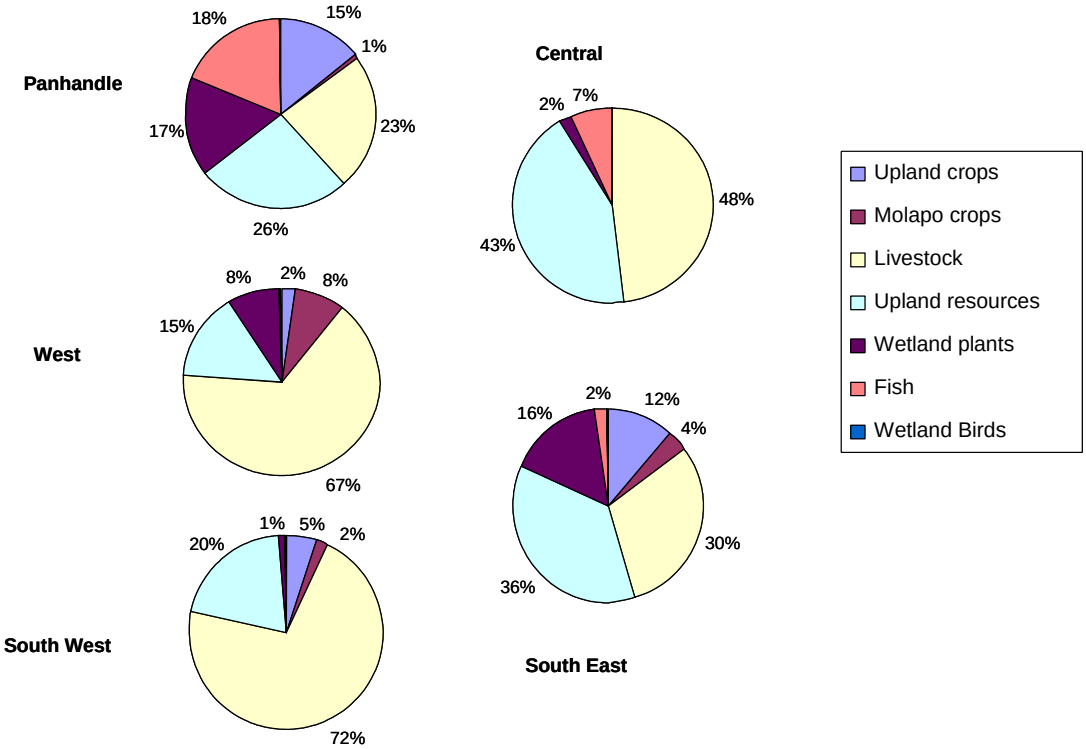

Figure 5-3 Estimated relative value of different sources of household livelihoods in the five different zones, based on estimated average net private income.

Table 5-49 summarises the net private values associated with all household activities in the different zones of the Ramsar site, and it also shows the proportion of these values derived from the wetland. Overall, the delta contributes 31% of the value gained from agriculture and natural resource use. It should be noted that there are also costs associated with the delta that have not been quantified explicitly, but which are accounted for in the above values. These include the transmission of disease and predation on livestock, and the loss of crops to wild animals (see Barnes 2006).

Table 5-49 Summary of the annual private values associated with household natural resources use and agricultural activities in the five zones of the Ramsar site and the contribution of the wetland itself (Pula, 2005)

	Pan-handle	**West**	**South West**	**South East**	**Central**	TOTAL
Upland resources	4 455 802	2 647 276	1 603 807	7 818 836	1 439 804	17 965 525
Livestock	9 507 254	17 071 621	9 407 181	25 142 602	37 173	61 165 831
Upland crops	1 797 892	332 514	319 151	1 733 447	-	4 183 004
Molapo crops	43 375	1 350 992	129 373	644 534	23 377	2 191 651
Wetland plants	2 727 891	1 554 821	91 199	2 834 808	63 856	7 272 574
Fish	2 253 711	20 766	10 639	263 441	116 963	2 665 520
Wetland Birds	8 860	18 073	-9 558	-68 976	-	-51 601
Total Ramsar Site	20 794 785	22 996 062	11 551 793	38 368 692	1 681 173	95 392 505
Total from wetland	5 009 113	14 978 302	147 910	9 592 073	190 871	29 918 270

6 INDIRECT USE VALUE

6.1 Indirect use values of wetlands

Ecosystem functions may either generate outputs that form inputs into production processes elsewhere (in other words the benefits are realised off-site), or they result in engineering cost savings by performing functions that would otherwise require costly infrastructure or man-made processes. The output of these services is the indirect value of ecosystems, and is generally positively related to their health or integrity.

The literature reflects a great degree of consensus about the types of indirect uses of wetlands and the importance of indirect uses as compared to other use components. The following indirect uses are commonly distinguished:

1. *Flood attenuation and control*, which reduces the risks of and damage caused by floods;
2. *Groundwater recharge*, where the wetland enhances groundwater recharge, which becomes available for abstraction;
3. *Waste treatment and water purification*, where the wetland absorbs pollution and waste and purified the water. This use is also called nutrients cycling;
4. *Support the micro climate* around the wetland, which is essential for direct uses;
5. *Sediment retention*, where the wetland retains fertile sediment for the benefit of arable production and the capacity and lifetime of any downstream dam;
6. *Habitat for species breeding and nursery*. This use is closely linked to biodiversity maintenance;
7. *Chemical cycling or carbon sequestration.* Wetlands are carbon sinks and therefore contribute towards reducing carbon emissions;

The estimation of indirect use values requires in-depth understanding of the ecosystem under review, and inadequate ecological knowledge is often a constraint for their estimate. In the absence of the required ecological knowledge, assumptions need to be made in order to estimate values.

6.2 Reported values of indirect uses of wetlands

A brief review of the literature showed that indirect uses are less tangible and more difficult to value than direct uses. Many valuation studies omit indirect use values entirely or only cover a few of them. However, the available studies suggest that indirect use values are significant and often similar to or sometimes even larger than the direct use values.

In southern Africa, the Zambezi River Basin study estimated the value of five indirect uses: flood attenuation, groundwater recharge, sediment retention, water purification and shore line protection (Turpie *et al*, 1999). Details of the estimated indirect use values are given in Table 6-1. The indirect use values are significant, but they are lower than the direct use values. Studies for other parts of the world also demonstrate the significance of indirect use values. In New Zealand, Waikato region, the value of ecosystem services was estimated to be $9.4 billion and equalled GDP. The indirect use values of wetlands were estimated to be $1.2 billion or $39 800/ha (the highest land value after estuaries). Water based ecosystems contributed twice the value of land based systems. The indirect uses of wetlands are; storm protection, flood control, habitat, nutrient recycling and waste treatment (Waikato Regional Council, 2006 (www.ew.govt.nz).

Pushpam (2001) finds that the value of ecological functions of a wetland (3250 ha of floodplains near New Delhi) was very high at Rs. Lakhs 1452 per annum or around Pula 210 per annum (direct and some indirect use values). Sathirathai (not dated) found that in southern Thailand conversion of mangrove wetlands into fish farms is financially viable but economically unviable because of the high indirect use values of mangroves. In addition, conversion raises equity concerns as only a few fish farmers benefit, and local communities carry the costs.

Table 6-1. Net present value of estimated indirect use values of the Zambezi River basin

Indirect use	Method	Coverage	Estimated value
Flood attenuation	Damage costs	Agriculture Infrastructure Personal losses	Over US $ 3.1 million
Groundwater recharge	Replacement costs	Boreholes and shallow dug wells	Over US$ 16.4 million
Sediment retention	Damage costs avoided for infrastructure		At least US $ 8.9 million
Water purification	Replacement costs and costs of up-grading existing infrastructure	Waste and pollution	US$ 44 million
Shore line protection	Damage costs avoided		
Carbon sequestration			US$ 110 million
Total			**Over US$ 182.4 million**

Source: Turpie *et al*, 1999, p. 209.

In Bintuni Bay, Indonesia, the annual average household income from mangrove wetland sources amounted to Rupee (Rp[2]) nine million or around Pula 5 340 (Barbier *et al*, 1997); the bulk (RP 6.5 million) was derived from traditional uses such as fishing, hunting, gathering and manufacturing. Two indirect use values were estimated:

- Erosion control based on its value to support local agricultural production. Rp 1.9 million per household per annum;
- Biodiversity (Rp 0.6 million), captured through aid flows and international transfers for conservation projects.

The estimates of indirect use values from the literature are summarised in Table 6-2.

Table 6-2. Indirect use values associated with different ecosystem functions

Indirect Use	Estimated value	Sources
Flood attenuation and control	Global costs of flooding US$ 27.3 billion in 2002Beneifts of flood control of wetlands exceed US$ 1750/ha. Flood control damage in Zambezi River basin US$ 3 million	 SIWI, 2004
	Flood control value of wetland near Washington-USA is US$ 10 to 50 000/ha	Turpie *et al*, 1999; SIWI, 2004.
	Flood control in Vientiane- Laos estimated at US$ 2 million p.a.	Leschine, 1997
Groundwater recharge	Zambezi River Basin: US$ 16 million	Turpie *et al*, 1999; SIWI, 2004.
Waste treatment-water purification	Value of mangrove wetlands is US$ 5 820/ha	Lal, 1990 quoted in Spannink and van Beukering, 1997
	Water purification in Zambezi River basin estimated to be US$45 million	Turpie *et al*, 1999; SIWI, 2004
Carbon sequestration	Mangrove wetlands carbon sink of 36 to 220 tonnes/ha	Spannink and van Beukering, 1997
	Cost of Co2 is US$ 20/ton	Spannink and van Beukering, 1997
Aggregate indirect use values of wetlands	Swamps and flood plains: US$ 9 990/ha/annum Mangrove wetlands US$ 6 075/ha/annum Lakes and rivers: US$ 19 580/ha/annum	SIWI, 2004
	Uganda: indirect use value of inland water resources is estimated to be US$ 300 million per annum (forest catchment protection, erosion control, water purification)	SIWI, 2004.
	Total indirect use value of Zambezi River basin is US$ 64 million	Turpie *et al*, 1999; SIWI, 2004.

[2] 1 Pula = Indonesian Rp 1685; 1 Pula = Thais Baht 7 (exchange rates June 2006).

6.3 Indirect use values in the Okavango Delta Ramsar site

6.3.1 Introduction

A review of the different indirect use values led to the conclusion that five indirect uses are most important. These are groundwater recharge, wildlife refuge, carbon sequestration, water purification and scientific and educational value. The value of flood attenuation is minimal, as the delta has the capacity to absorb high water levels internally without significant outflows. Even if outflows would occur, it is expected that very little damage will occur downstream as there are hardly any vulnerable settlements and pieces of infrastructure (e.g. bridges, roads, power lines). Most of the outflow would be channelled into the Boteti River and lake Ngami, both of which have been dry mostly since the 1990s. They would be able to absorb most outflows that might emerge from the delta. Similarly, the value of sedimentation retention is minimal as the outflow is minimal, and virtually all sedimentation is retained inside the delta, mostly in the channels (Jacobson *et al*, 2005). Sedimentation is estimated to be 209 000 t/ annum of clastic sedimentation (170 000 t/annum of bed load) on the upper fan and 381 000 t/annum of dissolved load on the lower fan (Jacobsen *et al*, 2005, p. 2 app.3). Bed load is only transported in the primary channels and other loads through channels and overland flows. All sedimentation stays in the swamps.

Below, the estimates of the five remaining indirect uses are discussed prior to the integral discussion of the indirect use value of the delta.

6.3.2 Groundwater recharge

The Okavango Delta provides a conduit for the recharge of groundwater aquifers which are utilised around the perimeter of the wetland. Since most of the population of the Ramsar site is concentrated close to the perimeter of the wetland it is reasonable to assume that the groundwater used by these communities has been replenished from the delta. The value of groundwater abstraction in the study area is thus attributed to the delta.

The recharge value is estimated as follows. Firstly, the actual amount of groundwater abstraction has been estimated. Next, the unit value of groundwater has been estimated. Multiplication of both figures gives the indirect use value of groundwater recharge. Groundwater is abstracted in settlements for domestic use, businesses and government. It is also used for livestock. Other uses are minimal and have not been included. The estimate of groundwater abstraction for settlements has been derived from the Ramsar site land use plan (Plantec *et al.* 2006). Groundwater abstraction for livestock has been estimated using the livestock figures for Ngamiland and standard daily water consumption per type of livestock[3]. The groundwater abstraction is estimated to be 5.8 Mm^3 for the entire Ramsar site (Table 6-3). This amounts to around five percent of the estimated annual recharge. The remaining 95% of recharge evaporates, serves the ecosystem or is available for future use (option value).

Table 6-3. Estimated annual groundwater abstraction

Category of use	Details	Annual GW consumption (in Mm^3) Ramsar site
Domestic use and businesses	Maun	2.3
	other settlements	1.3
Livestock	Cattle	1.5
	Goats	0.1
	Sheep	0.0
	Donkeys	0.6
Total groundwater consumption per year		**5.8**

[3] It has been assumed that livestock relies on groundwater for ten months per year.

Ideally, the resource rent should be used as the water value. However, data are scanty, and the valuation options were limited. Therefore, the marginal production costs of groundwater water were used as an estimate of the value. The unit value of water was derived from the Maun Groundwater Development Project MGDP (2005), which can be considered as the marginal supply costs of groundwater in the southern part of the delta. The following assumptions were made:

- Water reticulation system has a lifetime of twenty five years;
- The average inflation rate for that period equals the discount rate (8 to 12%; Planning Officers manual);
- Actual abstraction equals the recommended pumping rates.

The unit water costs are estimated to be P2.76/m^3. Mmopelwa *et al.* (2005) found that in one ward in Maun, residents were willing to pay P77 per month into a fund for a more reliable water supply. Using the average monthly water consumption, this would amount to P1.88/m^3 in addition to the current payments which are on average P2/m^3 [4]. Therefore, the total willingness to pay could be estimated to be in the order of P2.50-3.00/m^3 or around the marginal supply costs. This figure is not necessarily representative for the Maun population as only one ward was covered.

Given these figures, a value of P2.75/m^3 has been used to determine the unit value of groundwater. Thus the delta is estimated to provide a groundwater recharge service to the value of some P16 million.

6.3.3 Carbon sequestration

Vegetation captures carbon dioxide, mitigating global warming. Differences and changes in vegetation and land use practices alter carbon sequestration. For example, the carbon sequestration of the delta is expected to differ from that of semi-arid dry lands. As established earlier, where carbon sequestration is included in valuation studies, its value is significant in comparison with other indirect use values. Most valuation studies apply a simple estimation method based on the damage and/or mitigation costs. The standard method is to estimate the carbon sequestration of land (in tons/ha) and multiply this by the estimated value of a captured ton of carbon.

This method has been used for this study too. However, it must be recognised that the estimation of both figures for the delta is fraught with uncertainty, as no reliable estimates are available for the carbon sink function of the different land categories within the delta.

Furthermore, no correction has been possible for the emission of CO_2 through bush fires. Bush fires are common and generate significant CO_2 emissions. It is in fact necessary to look at net carbon sequestration, i.e. capturing minus emissions through fires etc. However, it was not possible to estimate the CO_2 emissions associated with fires in the delta. Instead, the CO_2 figure used is a net figure, correcting for bush fires etc. in general (see below).

Carbon sink of savannas and the wetland
The literature on carbon sink is specialised, and rapidly developing. For this study, a rapid review of the literature has been made through existing networks and contacts (e.g. UNFCC, IPCC and IGBP). This review showed that tropical forests have received most attention as terrestrial carbon sinks due to their high CO_2 sequestration capacity (36-393 tons/ha; Yurpin *et al*, 1999; De Jongh and de Leeuw, 2004). However, the importance of savannas is increasingly recognised despite the relatively low carbon sink per ha. The importance is derived from their size and condition (Jose and Montes, 2001). Carbon sequestration is highly variable seasonally and annually (e.g. fires or not) and also depends on the state of savannas (Abril and Bucher, 2001; Kirschbaum, 2003). Overgrazing and land degradation reduce the carbon sink capacity, possibly even more than the conversion of savannas into agricultural land (Abril and Bucher, 2001). Jose and Montes (2001) estimate for savannas in Venezuela that the gross sink function is 192 TgC/annum but the net sink function (minus emissions) at around ten percent at 17.5 Tg C/annum (27463158 ha). Beringer *et al,* (forthcoming and pers. communication) estimate the net carbon sink of Australian savannas at 0.5 to 1.5 tons/ ha/ annum.

[4] This assumes a loss (or unaccounted water UAW)) rate of 20%. The actual UAW figure is currently much higher, and needs urgent and significant reduction!

The figures for carbon sinks that prevail in the literature vary significantly reflecting differences in vegetation conditions and measurements (net sink or storage).

The carbon sink capacity appears associated with biomass. No biomass estimates for the delta could be obtained[5]. The ODMP-vegetation study had at the time of this study not yet provided biomass estimates. In the absence of biomass data, the leave area (or LAI) index has been used to assess the relative weight of each land category as a carbon sink. This LAI was developed and estimated for the hydrological model (period 2000-2004; Jacobson *et al*, 2005; GRAS, 2004). It has been assumed that rarely flooded areas are similar to semi-arid rangelands. The latter are assumed to capture on average *net* one T/ha. Based on data for semi-arid Australian rangelands, the sink figures for the other land categories is proportional to the LAI value (Table 6-4). Table 6-4 shows that sequestration increases with flooding and the highest value is achieved in the seasonally flooded areas. The LAI in the panhandle is marginally higher than in rarely flooded areas due to the presence of papyrus.

Table 6-4 The leaf area index (LAI) by land category (average for 2000-04).

		Area (km^2)	Leaf area index	Carbon sink (T/ha)
1	water-pan handle	1,446	1.0810	1.0810
2	normally flooded area	2,152	1.3510	1.3510
3	seasonally flooded	2,328	1.3920	1.3920
4	Occasionally flooded	3,534	1.3580	1.3580
5	rarely flooded	19,322	1.0000	1.0000
6	Total	28,782		

Source: based on data provided by Mc.Donald and Moalafhi, DWA.

The costs of carbon

In the past, the value of one ton of carbon sunk was mostly through the mitigation and/or damage costs of global warming. A recent IPCC study has estimated the costs of carbon capturing and storage associated with power plants (IPCC, 2005). The development of carbon trading has opened the opportunity of using market prices (de Jongh and de Leeuw, 2005). Trading prices show a wide range depending on the type of projects (for example: compliant with the Kyoto Protocol or not), the nature of mitigation methods and market conditions (e.g. risks associated with the country involved). Examples of value estimates and values are provided in Table 6-5. It appears that reforestation and carbon trading are cheaper than technological mitigation measures with costs well below US$ 10/ ton C. Moreover, the costs of carbon capturing are less than those of carbon removal.

Table 6-5. Cost estimates of one ton of carbon (in US$).

Type of costs	Cost estimate	Literature source
Damage costs	US$ 13-20/ton C US$ 1-30/ton C	Turpie *et al*, 1999
Mitigation costs	Reforestation: US$ 1.20-2.83/ton C	De Jongh and de Leeuw, 2004
Carbon capturing Carbon removal	US$ 12-44/ton C; mean of US$26 US$ 15-53 ton C mean of US$ 33	IPCC, 2005 IPCC, 2005
Carbon trading prices	US$ 0.5-9/ ton C for compliant projects compliant with the Kyoto Protocol (KP) US$ 0.5-2/ ton C for KP non-compliant projects. US$ 3-30/ton C	De Jongh and de Leeuw, 2004 Ruitenbeek, pers. Com.

Conservatively assuming that the sequestration value of the delta is based on the lower costs, it appears reasonable to value one ton of carbon at US$ 5 in this study (or Pula 27 using an exchange rate of 1US$ = Pula 5.4). This value is therefore used in the valuation.

[5] The on-going vegetation study of the delta may yield biomass estimates at a later stage.

The value of carbon sequestration

Based on the above, the value of carbon sequestration was computed. The estimated value of carbon sequestration is P85.9 million per annum for the delta and P158 million for the entire Ramsar site. Comparing the value of the delta with that of semi-arid dry lands, it was found that the extra value of the delta was modest at P8.2 million for the wetland and the Ramsar site. This is less than 10% extra carbon sequestration value.

The results are very sensitive to the figures used for the carbon sink and the value of a sequestered ton of carbon. Sensitivity analysis has been carried out for two alternative values (US$10 and US$27) and three carbon sink figures (0.5 T/ha and 1.5 T/ha), all taken from the literature. The results of the sensitivity analysis are summarised in Table 6-6. The carbon sink value of the wetland ranges from a minimum of P43 million to a maximum of 645. The range for the entire Ramsar site is from P79 million to 1.2 billion. Our baseline assumptions are on the lower side of the range of the sensitivity analysis and appear reasonable. Given the uncertainty of the data used, the estimates are indicative and need to be used with caution.

Table 6-6. Indirect use values with different assumptions

	Value US$ 5/ha	Value US$ 10/ha	Value US$ 27/ha
Wetland			
Sink 1	86	172	428
Sink 2	129	258	645
Sink 3	43	86	215
Ramsar site			
Sink 1	158	316	791
Sink 2	237	475	1 187
Sink 3	79	158	396

Note: Sink 1: 1 T/ha for semi-arid rangelands; sink 2 : 1.5 and sink 3 0.5 T/ha of semi-arid rangeland

6.3.4 Wildlife refuge

Wildlife is the key resource for tourism and hunting in the wetland and Ramsar site. The Okavango Delta also provides refuge for wildlife that migrate to other parts of the Ramsar site and beyond, generating benefits and use value in the form of ecotourism and hunting in those areas. This is not covered under the direct use value (chapter 4 and 5), and therefore treated as an indirect use value.

The delta (and Chobe) is the major wildlife areas in northern Botswana and species such as buffalo and elephants move in and out of these areas depending on rainfall and range conditions. The recently re-introduced white rhinos have moved over long distances towards the west and south-east. The buffalo fence on the western and southern sides of the delta has restricted movements towards the south and west. Elephants and buffalo move towards the north-east and east (towards Caprivi) while wildebeest and zebra move towards the west and south east (Makgadikgadi Pans; KCS, 1983).

In consultation with a group of wildlife experts[6], the following method was employed:

- Identification of the valuable migratory wildlife species;
- Estimation of their use for tourism and hunting outside the Ramsar site and wetland; and
- Valuation of related eco-tourism and hunting.

The IUV of wildlife refuge was calculated both for the wetland itself (as defined under the hydrological model) and for the entire Ramsar site. The external wildlife refuge value of the wetland includes wildlife values realised inside the Ramsar site but outside the wetland. The indirect use value of the wetland's wildlife refuge is therefore higher than that of the entire Ramsar site.

[6] The method and estimates have benefited from inputs and comments by Dr. C. Taolo, Dr.D. Gibson, Dr. J. Perkins and J. Broekhuis.

Valuable migratory wildlife species

The main species that generate value *outside* the wetland were identified from the literature and discussions with experts. The following species were identified as most important:

- Mammals: elephant, buffalo, lion, wildebeest; and zebra. While wild dogs are also considered important, their number is very small, and they do not feature in aerial surveys;
- Bird species: the wattle crane and slated egret.

DWNP aerial surveys provided figures regarding the number of animals in the wetland. The importance of the wetland for elephants and buffalo is clearly illustrated by the aerial surveys (Table 6.7). In addition, Ngamiland accounts for almost half of the country's lion population.

The comparison of wet and dry season resources (1999) demonstrates the mobility of elephants and buffalo in and around the wetland. During the wet season, numbers are less than half of the dry season when animals converge in search of water and grazing. The mobility of buffalos appears highest followed by elephants and (much less) wildebeest. The dry season location of elephant and buffalo is shown in Figure 6-1 and Figure 6-2.

Table 6-7. Numbers of selected species in the delta, Chobe and Botswana at large.

	1999D	1999W	2001	20002	2003	2004
Elephants						
Delta	30971	12847	18175	28550	19079	27917
Moremi	5442	2499	6048	9562	5862	9143
Ngamiland		50056	67808	65438	57381	74885
Chobe	22053	21486	33219	31598	30348	32263
Botswana total	*120604*	*106494*	*116988*	*123152*	*109471*	*151000*
Buffalo						
Delta	63965	13767	41373	31252	15233	8748
Moremi	40160	260	23044	4585	597	1089
Ngamiland		15110	62695	36985	17697	15457
Chobe	4903	862	1788	252	5304	10603
Botswana total	*93766*	*18239*	*73254*	*40871*	*33305*	*31615*
Wildebeest						
Delta	14080	14720	3970	8446	3076	2248
Moremi	4429	2597	6292	6109	236	980
Ngamiland		17986	11201	14065	5765	5359
Chobe	0	34	188	147	0	145
Botswana total	*46741*	*30533*	*26870*	*46681*	*45858*	*35088*
Lion						
Delta						
Moremi						
Ngamiland		98	77	231	91	258
Chobe						
Botswana total	*1517*	*518*	*405*			*621*

Note: figures for 2000 up to 2003 refer to dry season surveys. Surveys were last done in both the wet and dry season in 1999 (1999D and 1999W respectively).
Source: DWNP wildlife aerial surveys.

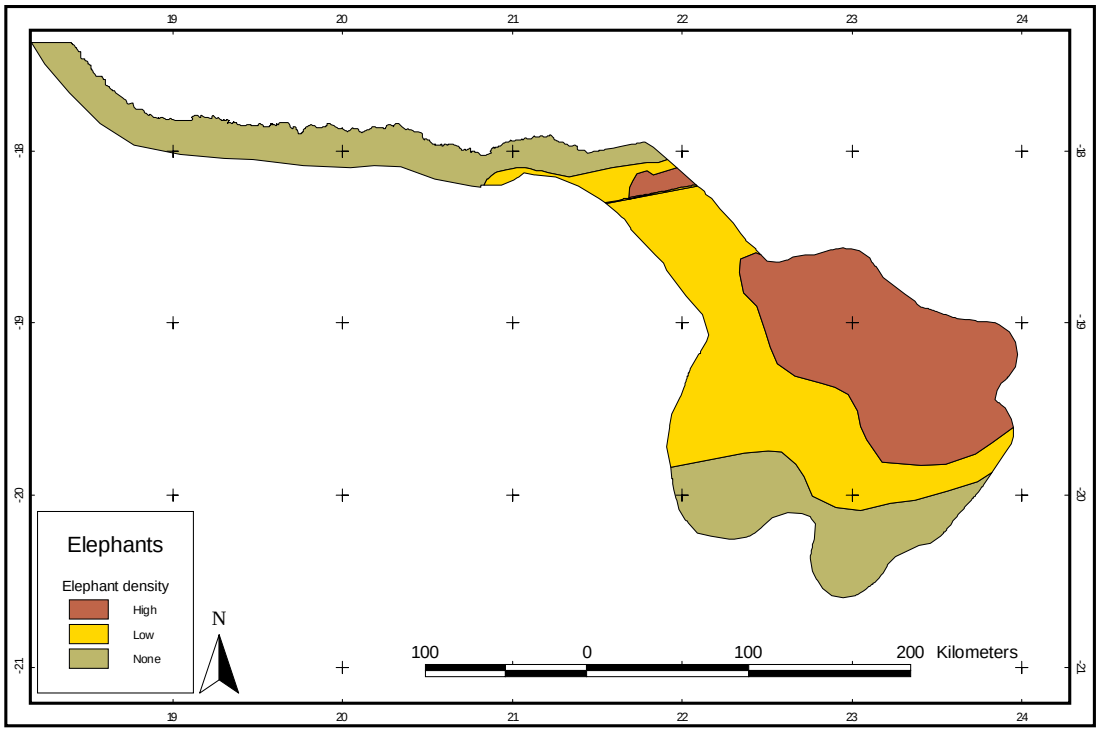

Figure 6-1. Dry season distribution of elephant. Source: ODMP data base

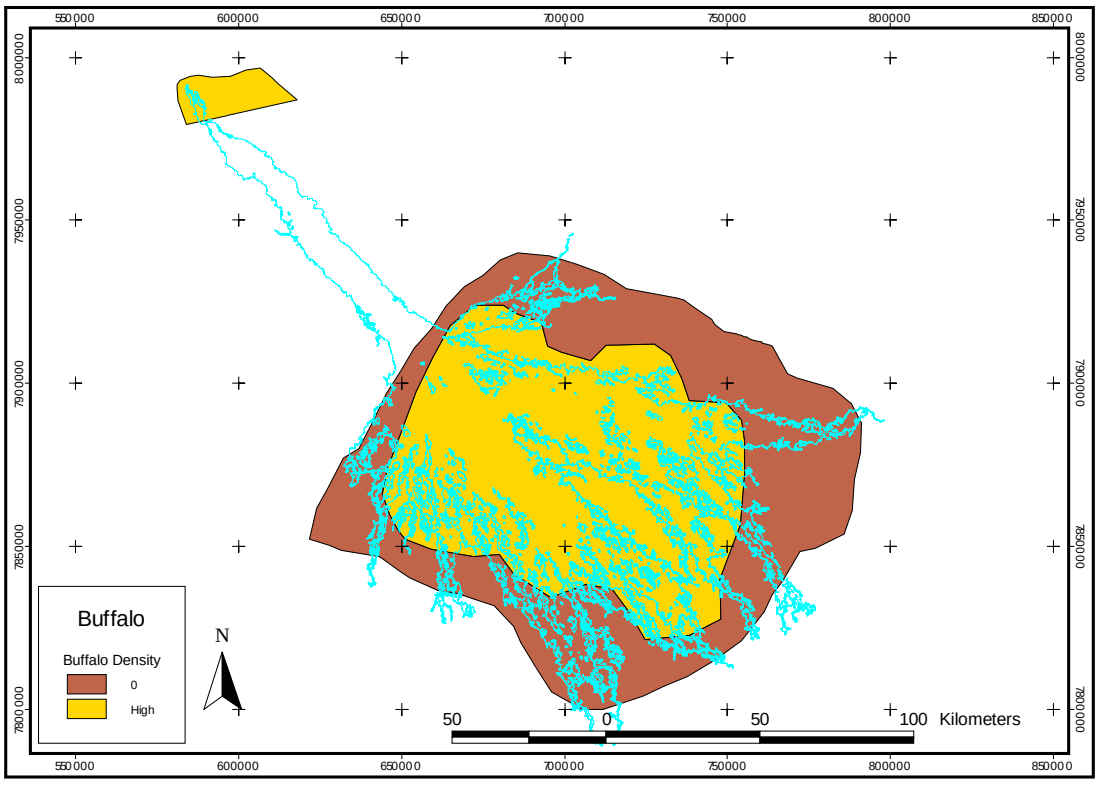

Figure 6-2. Dry season distribution of buffalo. Source: ODMP data base

External wildlife uses

In order to estimate the indirect use value, the external areas needed to be defined first:

- *External to the wetland*: around half of the (drier) parts of the Ramsar site, all of Ngamiland outside the Ramsar site and Central district (concession areas);
- *External to the Ramsar site*: all of Ngamiland outside Ramsar site and Central District (concession areas).

It has been assumed that all hunting quotas in these areas could be attributed to wildlife associated with the wetland. Hunting and eco tourism are the most important uses of migratory wildlife outside the wetland. The hunting quotas for the species outside the wetland were obtained for the years 2005 and the on-going hunting season 2006. While the total number of hunting quotas decreased from 2005 to 2006, the quotas for valuable species such as elephant increased. The number of quota is relatively small, but their value is significant as elephant, lion and buffalo are high value species. These species account for the bulk of the income of the hunting industry (ULG, 2000). Data on ecotourism are scarce, and the value of ecotourism has been determined as a percentage of hunting.

Species values

The species values have been derived from the 'model hunts' used in the 2000 review of the hunting industry (ULG, 2000). For example, a model hunt of five elephants was assumed to take twenty one days for five elephants at a price of US$ 221 000 or 44 200 per elephant. The latter is equivalent to P 221 000, using the exchange rate of US$ 1- Pula 5.4. The estimated indirect value associated with hunting would be in the order of P 30.3 million per annum for the Ramsar site and P 51.2 million for the wetland. Over eighty percent is attributed to elephant hunting.

Table 6-8. Estimated indirect use value of wildlife related to hunting (2005)

Species	value in Pula	Other Ramsar site and rest of Ngamiland Quota	Central quota	Total value (million P)
Wetland area				
Buffalo	78300	71.25	8	6.2
Elephant	238680	149.4	29	42.6
Lion	127980	12.1	3	1.9
Wildebeest, blue	5130	53.75	3	0.3
Zebra	5000	37.2	6	0.2
Total				**51.2**
Ramsar site				
Buffalo	78300	21	8	2.3
Elephant	238680	82.4	29	26.6
Lion	127980	6.1	3	1.1
Wildebeest, blue	5130	29.75	3	0.2
Zebra	5000	24.2	6	0.2
Total				**30.3**

Note: wildebeest and zebra only license and trophy value.
Source: DWNP hunting quota 2005; ULG, 2000.

Data for the estimates for the off-site value of eco-tourism are scarce and incomplete. Therefore, the value of off-site tourism has been estimated as a fraction of the hunting income. DWNP data on royalties of concession holders were used to estimate the ratio of gross incomes of the hunting and ecotourism sub-sectors. The share of tourism was roughly half that of the hunting sector. It is further assumed that the indirect use value of valuable birds such as the slated eagle and the wattle crane is included in this estimate. Therefore, the indirect value of off-site tourism is estimated to be P25.6 million for the wetland area and P15.2 million for the Ramsar site. The total value is estimated in Table 6-9. The indirect use value of wildlife refuge has increased in 2006, mostly due to an increase in elephant hunting quotas.

Table 6-9. Estimated IUV for wildlife refuge for the wetland and Ramsar site

	2005	2006
Wetland	68.5	76.8
Ramsar site	33.4	45.5

An attempt was made to assign indirect use values of wildlife refuge to the different land category based, based on their importance as wildlife refuge. While most wildlife resources are found in the southern part of the delta, the normally flooded areas and the panhandle ultimately determine the fate of wildlife species[7], and therefore the weight of both areas is relatively high. Each category has been given a weight of 0.3, indicative of the fact that most wildlife would not survive without these areas. The other categories are considered to be equally important for wildlife and therefore have been given weights of 0.1333 each.

Table 6-10. Indirect use value of delta wildlife by land category (Pula million; 2005).

	Land category	area (km^2)	Hunting value	Eco tourism value	total value
1	water-pan handle	1,446	15.4	7.7	23.1
2	normally flooded area	2,152	15.4	7.7	23.1
3	seasonally flooded	2,328	6.8	3.4	10.2
4	occasionally flooded	3,534	6.8	3.4	10.2
5	rarely flooded	19,322	6.8	3.4	10.2
	Total	***28,782***	**51.2**	**25.6**	**76.8**

Table 6-10 clearly shows that the panhandle and the normally flooded areas are most valuable for wildlife. The growth of the tourism sector is expected to lead to an increase in the indirect use value of the wetland's wildlife. Assuming that tourism would be at par with hunting, the value would increase to P 48.8 million.

6.3.5 Purification of water

The environment has the natural ability to absorb some pollution without a cost to society (e.g. water treatment costs). Purification of water is therefore an indirect use value.

The study looked primarily at wastewater generated by the domestic sector, businesses and government and in tourism camps.

The population density in and around the wetland is very low. Most people live in Maun and in a cluster of villages in the panhandle. There are very few commercial sources of pollution. The use of pesticides and fertilisers in agriculture is minimal, and no significant industries that could cause significant pollution appear to occur in the Ramsar site. Villages and the growing number of tourist camps are probably the main sources of pollution.

In order to value the water purification function, the types and amount of pollution were estimated together with the value their natural purification.

Pollution sources and types

Most villages have a water reticulation system which offers three forms of access to water: 1. standpipes in villages; 2. a water connection inside the yard; and 3. a house connection. Water from standpipes is free of charge, but households are charged for yard and house connections proportional to the monthly use. Due to rising living standards private connections in the yard or house are increasing. According to the National Master Plan for Sanitation and Wastewater, only 26.8% of domestic water use is linked to waterborne sanitation, and only 10% of that is connected to the sewage system; ninety percent ends up in septic tanks and soak ways.

7 Personal communication Dr. J. Perkins.

Sanitary facilities are poorer. Almost half of the households in Ngamiland and Chobe do not have access to a toilet facility (own or communal). Just over ten percent has a flush toilet and almost thirty percent has a pit latrine; the remaining ten percent uses a communal facility. Sewage systems (with oxidation ponds) exist in Maun and Gumare. Shakawe is planned to have a sewage system in future. Therefore, most wastewater will be collected in septic tanks. The District Council empties septic tanks, but 'access to sanitation facilities is considered to be dismal (Plantec Africa *et al*, 2006, p. 130). Household waste is typically dumped and burned in a rubbish pit (63%). Only 10.9% of the waste is regularly collected. The rest is dumped along the roads or incinerated.

Most lodges have a system of septic tanks and soak away. The Prison in Maun has a water treatment schemes whose outflow is used for irrigation. The outflow of the treatment works in Maun is unlikely to affect the wetland as it is located south of the wetland.

Tourism camps, village septic tanks and uncontrolled waste disposal are considered to be the largest pollution risks.

Pollution estimates

Regarding domestic wastewater generation, water consumption for house and yard connection were estimated using average water consumption figures. It was assumed that:

- Houses with a house connection would return 80% of their water consumption. In Maun and Gumare, 90% of that would flow into septic tanks and 10% into wastewater treatment works. In other villages all water would flow into the septic tank and soak ways.
- Houses with a yard connection would use pit latrines, and not generate overflow from septic tanks.

The estimated amount of generated effluent through WWTW and septic tanks would be in the order of 0.6 Mm^3 per annum. It is difficult to estimate how much ends up in the wetland (if any). We have used the rough population weight and a wetland entry weight to estimate the effluent that might end up in the wetland and be cleaned. The closer one is to the wetland and the wetter the area is, the higher the risk of effluent filtering into the wetland. Therefore, it was assumed that 40% of the effluent from the panhandle could end up in the wetland and nothing from the rarely flooded areas. The areas with a different flood regime would have a percentage in between the minimum and maximum.

At present, there are sixty-two camps in and around the wetland with am estimated total of around four hundred room and eight hundred beds (source: ODMP data base). Most camps get water from the river/lagoons or from well and boreholes where camps are further away from surface water. Camps typically have septic tanks and soak ways, posing some danger of nitrogen and phosphate pollution. DWA did assess the water quality around camps in 2003, but the results have not yet been made available. According to DWA, there is need for more extensive and regular monitoring. Pollution may also occur from car washing and maintenance and solid waste. In principle, organic waste is usually decomposed in a pit, while other waste is burnt or returned to Maun. A review of the Camp inspection visits (source: ODMP data base) show regular violations of lease agreements and sub-standard waste disposal. Sub-standard waste disposal increases the risks of pollution of the wetland and its water resources. Car maintenance and (used) oil sites were often not bunded, increasing the risks of oil entering the wetland. Moreover, waste disposal in the camp and workers quarters was often found to be inadequate. It must be emphasized that management practices vary widely from camp to camp.

An estimate was made of the wastewater from camps (tourists and workers). Assuming an average bed occupancy rate of 40%, over 110 000 overnights would annually occur. Camp-based employment, including guides, is estimated to be two hundred and fifty. Assuming a daily water consumption of 70L/tourist/day and 16.5 L/worker/day, the total water annual consumption would be 9 450 m^3.

Cost of wastewater treatment

Treatment costs have been estimated from the NMPSWW (SMEC and Sinham, 2003) and based on the average of the treatment costs of Maun and Gumare (i.e. P 6/m^3).

Value of water purification
The value of purification of domestic effluent could be around P1 million. Assuming the same value for government and institution, the water purification value could be around P2 million excluding camps. Using a high cost estimate of water treatment in the camps of P20/m^3 and assuming that most effluent will end up in the Okavango, the purification value would not exceed P200 000.

Even if all domestic effluent would filter into the wetland, the mitigation costs would be estimated at only P 4.0 million (assuming no irreversible damage was done to the wetland). Clearly, the water purification value is currently modest in comparison to other indirect use values.

6.3.6 Scientific and educational value

The wetland and the ODRC are frequently used for research and educational purposes. The establishment of the Harry Oppenheimer Research Station (HOORC), the Wildlife Training Centre (WTC) and the large number of international research projects concentrated on the wetland demonstrate the research and information value of the delta. Moreover, a range of films have been produced about the delta.

The scientific and educational value is estimated by valuing the research, filming and educational activities associated with the delta. These are gross values as they reflect the budget of the activities, and costs are not intermediate costs deducted. An inventory was made of the Okavango activities of HOORC, DWNP, ODMP, private sector and NGOs. The results are summarised in Table 6-11. These figures are conservative as no figures could be obtained for some of the activities.

The annual scientific and educational value is estimated to be P24 million for the Ramsar site and P18 million for the wetland. Even without ODMP, the S & E value would be P17 million for the Ramsar site and P13 million for the wetland. The private sector (research and films) and NGOs account for the largest value.

Table 6-11. Scientific and educational value (in P million)

Category	ODRC	Wetland
HOORC	6.4	6.2
DWNP	0.5	0.5
ODMP	6.9	5.7
Private/ NGOs	10.1	6.1
Total	**24**	**18.5**

Sources: HOORC Annual report 2004/05; ODMP inception report and data provided by researchers.

Research is the most important component, accounting for around eighty percent of the estimated value. Education, including films, makes up the remainder.

An effort was made to establish whether international or national funding was used. The inventory shows that around two-third of the funding is international and one third domestic. This demonstrates the international component of this value component (as with tourism).

6.4 Overall estimate of indirect use values

The results of the estimated indirect use values are brought together in Table 6-12. The indirect use value of the wetland is estimated to be P199 million, compared to P230 million for the entire Ramsar site. Carbon sequestration accounts for the largest component of the indirect use value followed by wildlife refuge, scientific and educational value, groundwater recharge and water purification. The wetland is critical to the indirect use value, as can be seen from the much higher indirect use value: the average IUV per ha is about P69 for the wetland and P41 for the Ramsar site as a whole.

Table 6-12. Summary of estimated indirect use values for the Ramsar site and the wetland (2005 Pula)

Service	Wetland	Rest of Ramsar site	Whole Ramsar site
Groundwater recharge	P16 million	0	P16 million
Carbon sequestration	P86 million	72	P158 million
Wildlife refuge	P77 million	0	P77 million
Water purification	P2.2 million	0	P2.2 million
Scientific and educational value	P18 million	6	P24 million
Total	P199.2 million	P31 million	P230.2 million
Area	28 782 km^2	26 765 km^2	55 547 km^2
Average per ha	P69	P29	P41

The results show that carbon sequestration and wildlife refuge are the most valuable indirect uses accounting together for over eighty percent of the indirect use value of the wetland and Ramsar site. The scientific and educational value is significant, and exceeds that of groundwater recharge and water purification. The wetland and Ramsar site is a major focal point for research, documentaries and education.

If one compares the indirect use value of the wetland with that of the surrounding semi-arid savannas within the Ramsar site, the extra or *marginal* indirect use value of the wetland is considerably lower. This is the 'premium value' of the delta. The marginal indirect use value of the wetland is more than half of its full IUV. Wildlife refuge, water purification and groundwater recharge are wetland functions, whereas carbon sequestration and scientific and educational value is provided by both wetland and upland areas.

Given the many assumptions that were made and the use of 'soft data', it may be more informative for policy makers to know the range of indirect use values (Table 6-13).

Table 6-13. Range of estimated indirect use values (Pula million 2005).

	Wetland	Ramsar site
Carbon sequestration	50 to 250	80 to 350
Groundwater recharge	12 to 20	12 to 20
Water purification	3 to 5	3 to 5
Wildlife refuge	60 to 80	30 to 45
Scientific and educational value	15 to 20	20 to 25
Total, incl. carbon sequestration	**P 140 to 375 million**	**P 145 to 445 million**
Total, excl. carbon sequestration	**P 90 to 125 million**	**P 65 to 95 million**

The estimated indirect use values are well below the values of average swamps and wetlands. According to Costanza (quoted in SIWI, 2004) the average indirect use value of swamps is US$9 990/ ha compared to our result of US$12 for the wetland and US$ 8/ha for the Ramsar site. The estimated indirect use value per hectare is also considerably lower than that of the Zambezi[8]. The relatively low value can be attributed to two main factors:

1. Unlike in most wetlands, flood attenuation and sediment retention is of low importance in the wetland. Flood attenuation and sediment retention represent significant values in other studies;
2. The value of water purification and groundwater recharge is relatively small because of the low population density and human influence on most of the wetland: waste generation is small and so is groundwater abstraction.

Interestingly, the indirect use values prove to be higher than the direct use value, if tourism is not considered. In contrast, the direct use values in the Zambezi valuation exceeded the indirect use values. The difference is caused by the relatively un-spoilt nature of the Okavango Delta associated with low levels of direct use, low population density and large distances to non-tourism markets.

[8] This study used NPV, which is not directly comparable with annual values.

7 OPTION AND NON-USE VALUE

Option value is the 'future use value" that could be derived from the area, but which as yet to be realised. Maintaining biodiversity is believed to retain the option to generate such values in future. These values could be, for example, from the exploitation of hitherto unexploited species, the discovery of important genetic material of use in the pharmaceutical industry, or the future tourism or development potential of the area. It is not possible to measure option value, since no-one can predict the future, but it is important to bear this in mind as a potential opportunity cost of degradation.

Existence value is the appreciation people derive from the knowledge that something exists, while bequest value is the value derived from knowing that one's children will be able to enjoy something in the future. The growing popularity of the environmental movement indicates the substantial worth of biodiversity, particularly verified by people's willingness to donate to help protect species and ecosystems they have never, and will never, directly interact with. The Okavango Delta contains noteworthy biodiversity, although it is not particularly well endowed with endemicity. Perhaps the greatest attribute of the delta in this regard is its extent and intactness as a wilderness area. Anything that impinges n this pristine-ness is likely to affect the utility derived by people from this area.

Value may also be placed on the intactness of traditional peoples and practices. Much of the traditional culture persists and is a source of pride. Degradation of the wetland and its resources might ultimately lead to an element of cultural decay. This decay may result from the loss of traditional plants for food and medicine, for example. Other more abstract impacts may result from the breakdown of gender roles without re-enforcement of such activities as hunting and collecting or a widening rich-poor disparity.

Estimating the existence value (including bequest value) of the Okavango Delta would require a substantial undertaking, involving the use of contingent valuation, a survey based method (Arrow *et al*. 1993). It would involve eliciting a willingness to pay from all those who derive such utility from the area. Since the Okavango Delta is of world renown, this should ideally be a global study. It is probable that the existence value among the international community far exceeds that of Botswana nationals' existence value of the delta, or their 'willingness to pay' for its continued existence.

The measurement of existence value was beyond the scope of this study. However, at least two studies have considered this problem at some level. Barnes (1996) surveyed visitors to Botswana and ascertained the amount they were willing to pay towards a conservation fund for Botswana's wildlife. Tourists were willing to pay P125 on average, suggesting a total aggregate willingness to pay (WTP) among users alone of some P8 million (equivalent to about $4 million at the time).

Mmopelwa (2005) conducted a contingent valuation survey in the Delta area in which both resident households and visitors were asked what they would be willing to pay to a conservation fund to ensure conservation of the Okavango delta. Households were allowed to express this in terms of livestock or produce. 70% of households and 33.3% of tourists had a positive WTP. Households had a mean WTP of just under P50, amounting to a total of about P53 000. Tourists had a mean WTP of about P1050, amounting to an estimated total of P13 million. Note that in both of these studies this is a once-off payment, and not an annual value.

These estimates greatly underestimate the existence value of the delta, however, as they only reveal the WTP of those that people that happened to be visiting the delta in a particular year. In this regard, one could assume that similar WTP prevails for each new visitor to the delta, and given that most visits are once-off, that the values could be assumed to be annual as a minimum estimate. However, this still only considers visitors to the delta. There are a great deal more people, including many who cannot afford to visit the area, who would express a willingness to pay for conservation of this area. This would include both Botswana nationals and the global community. For example, the existence value of South African biodiversity is estimated to be at least $263 million per year to South Africans alone (Turpie 2003). Indeed, many studies have found that existence value far exceeds the direct use value of ecosystems (refs). Thus there is a strong case for conducting a proper study of the existence value of the Okavango Delta that takes the non-user community into account.

8 THE VALUE OF THE OKAVANGO DELTA IN THE ECONOMY OF BOTSWANA

The results and discussions presented above cover the components of total economic value, referred to in chapter 3, above. This chapter summarises these findings, and examines the economic values of the study are in the context of the economy of Botswana. It provides an opportunity to compare the different values, to measure the impact of the study area on rural livelihoods, to measure the impact of the study area on the broader economy, and to measure the value of the study area as a natural asset.

8.1 Total economic value of the delta in the Botswana economy

Tables 8.1 and 8.2 contain summaries of all the direct use values of the study area. In table 8.1, the values for the whole Ramsar Site are included, while in Table 8.2, those values attributable only to the wetland are included.

In terms of direct use value, by far greatest values in tables 8.1, and 8.2 are those for the use of the natural resource base for tourism. The gross output associated with tourism in the Ramsar site is estimated to be P1.1 billion, while that for agricultural activities is only P92 million, and that for natural resource harvesting and processing is only P32 million. Most of the very high tourism output is attributable to the wetland (P1 billion). Nearly all the agricultural output in the Ramsar site is attributable to the drylands in the site, and only one thirtieth P2.8 million of it is attributable to the presence of the wetland. About half (P17 million) of the natural resource harvesting and processing output is attributable to wetland.

Tourism in the Ramsar site directly contributes an estimated P400 million to the gross national product and most of this, some P363 million, is attributable to the actual wetland. Agricultural resource use, overwhelmingly dominated by livestock production in the Ramsar site contributes an estimated 43 million to the gross national product. The contribution of the wetland to this is small, being only P1.4 million. Natural resource use (harvesting and processing) in the Ramsar site contributes an estimated P29 million to the gross national product. The wetland contributes about half of this, or P15 million.

In chapter 6 we attempted to value the ecological services provided by the Ramsar site and the wetland. Only some of these indirect use values would be reflected in the conventional measures of the national economy. Thus, the value of the delta as a refuge for wildlife which is used off-site, specifically outside the Ramsar site, for tourism can be considered to contribute amounts to the gross national product that are additional to the tourism values described in Tables 18.1 and 18.2. Thus from Table 6.13, it can be seen that a gross output of some P33 million in tourism value (trophy hunting), which would involve an estimated P18 million in gross value added to the national product.

The effects of other ecological service values, and the option and non-use values, associated with the delta, on the economy of Botswana are very difficult to estimate. Those that can be captured though appropriate international markets, such as carbon sequestration services, and the willingness to pay for delta preservation (option and existence values) can ultimately contribute to national income.

Table 8-1 Summary of the direct economic use value of the Okavango Delta Ramsar site (P'000, 2005)

RAMSAR SITE	Direct Gross output	Direct GNP Contribution	Natural resource rent
Tourism accommodation	**675 360**	**327 990**	**158 450**
Lodges/Camps (non-consumptive)	445 580	209 460	102 480
Camps (trophy hunting)	103 190	56 890	29 930
Mobile & self-drive safaris	93 290	43 230	18 660
Guest houses, B&Bs, motels	19 660	12 240	4 520
Hotels	13 640	6 170	2 860
Tourism-linked activities	**440 450**	**72 980**	**33 160**
Restaurants/bars (independent)	110 180	15 930	7 710
Transport (air charter, airline, road)	105 480	17 980	8 440
Travel agents, guiding services	47 220	9 470	4 250
Shopping	166 590	24 270	11 660
Additional CBNRM income	10 980	5 330	1 100
Subtotal Tourism	**1 115 810**	**400 970**	**191 610**
Crop production	**9 030**	**2 770**	**320**
Crops – molapo	2 770	1 370	190
Crops – dryland	6 270	1 400	130
Livestock production	**83 210**	**39 760**	**950**
Livestock - cattle posts	74 560	34 370	0
Livestock - village	8 650	5 390	950
Subtotal agriculture	**92 240**	**42 530**	**1 270**
Natural resource harvesting	**26 800**	**24 050**	**16 420**
Fishing	3 190	3 160	690
Firewood	9 260	8 910	7 870
Poles, withies	1 880	1 730	1 600
Timber	600	600	340
Grass	4 420	4 380	2 480
Reeds	2 460	2 330	1 380
Papyrus	30	20	10
Palm leaves	1 880	1 880	1 050
Veld foods	1 480	1 480	830
Medicines	300	290	170
Birds	920	-420	0
Other wildlife	380	-310	0
Natural resource processing	**4 830**	**4 740**	**680**
Craft products	2 010	1 990	280
Food products	2 530	2 530	350
Wood products	290	220	40
Subtotal natural resource use	**31 630**	**28 790**	**17 090**
TOTAL Ramsar direct use values	**1 239 680**	**472 290**	**209 980**

Table 8-2 Summary of the direct economic use value of the Okavango Delta wetland (P'000, 2005)

OKAVANGO DELTA WETLAND	Direct gross output	Direct GNP Contribution	Natural resource rent
Tourism accommodation	**614 380**	**296 580**	**142 800**
Lodges/Camps (non-consumptive)	422 340	198 520	97 140
Camps (trophy hunting)	73 200	40 290	21 230
Mobile & self-drive safaris	88 340	40 940	17 670
Guest houses, B&Bs, motels	18 180	11 330	4 180
Hotels	12 320	5 510	2 590
Tourism-linked activities	**398 150**	**66 180**	**29 980**
Restaurants/bars (independent)	99 470	14 390	6 960
Transport (air charter, airline, road)	95 170	16 230	7 610
Travel agents, guiding services	43 730	9 090	3 940
Shopping	150 460	21 940	10 530
Additional CBNRM income	9 330	4 530	930
Subtotal Tourism	**1 012 530**	**362 760**	**172 780**
Crop production	**1 190**	**590**	**80**
Crops – molapo	1 190	590	80
Crops – dryland	0	0	0
Livestock production	**1 690**	**870**	**190**
Livestock - cattle posts	0	0	0
Livestock - village	1 690	870	190
Subtotal agriculture	**2 870**	**1 460**	**270**
Natural resource harvesting	**13 310**	**11 870**	**6 760**
Fishing	3 190	3 160	690
Firewood	1 850	1 780	1 570
Poles, withies	380	350	320
Timber	120	120	70
Grass	2 700	2 680	1 510
Reeds	2 460	2 330	1 380
Papyrus	30	20	10
Palm leaves	1 880	1 880	1 050
Veld foods	100	100	60
Medicines	150	150	80
Birds	180	-480	0
Other wildlife	260	-210	0
Natural resource processing	**3 480**	**3 440**	**490**
Craft products	1 900	1 880	270
Food products	1 520	1 520	210
Wood products	60	40	10
Subtotal natural resource use	**16 790**	**15 310**	**7 240**
TOTAL wetland direct use values	**1 032 190**	**379 530**	**180 290**

8.2 Impact on rural livelihoods

The direct use values of the Okavango delta are overwhelmingly dominated by the use of natural wetland assets for tourism activities in the central zone. The tourism activities generate income (value added) which accrues to earners of salaries and wages, investors and government. The next section examines the allocation of income resulting from use of the delta in the broader economic context. But it is interesting to measure the impact that these activities have directly on local livelihoods.

That component of value added by use of the resources of the Ramsar site and the wetland, which accrues directly to local low-income households, is estimated in Table 8.3 and Figure 8-1. In the Ramsar site as a whole, local communities earn significant amount in profits from direct use of natural resources. Significant amounts are profits in-kind (consumed directly) while in the case of livestock, and in particular cattle post livestock, important cash profits are also earned from sales. Local low-income households earn comparable amounts through salaries and wages earned in the direct use of the delta's resource for tourism activities. Low income communities also derive income collectively through rentals and royalties from CBNRM joint ventures in the tourism sector.

Table 8-3 Estimated direct contribution of the Okavango Delta Ramsar site and wetland to the livelihoods of low income rural households in Ngamiland (P'000, 2005)

RAMSAR SITE	**Profits in-kind**	**Profits cash**	**Salaries & wages**	**Rentals & royalties**
Non-consumptive tourism services	0	0	72 800	18 990
Hunting tourism services	0	0	13 410	5 650
Tourism linked activities	0	0	5 080	0
Additional CBNRM income	0	3 180	1 320	0
Subtotal Tourism	0	3 180	92 620	24 640
Crop production	5 330	1 060	1 150	0
Livestock production	17 560	43 610	7 820	0
Subtotal Agriculture	22 890	44 670	8 980	0
Natural Resource Use	21 070	7 340	150	0
TOTAL LIVELIHOOD CONTRIBUTION	**43 950**	**55 190**	**101 750**	**24 640**
WETLAND	**Profits in-kind**	**Profits cash**	**Salaries & wages**	**Rentals & royalties**
Non-consumptive tourism services	0	0	68 830	18 060
Hunting tourism services	0	0	9 520	4 320
Tourism linked activities	0	0	4 610	0
Additional CBNRM income	0	2 710	1 120	0
Subtotal Tourism	0	2 710	84 080	22 380
Crop production	850	100	140	0
Livestock production	810	390	310	0
Subtotal Agriculture	1 660	490	450	0
Natural Resource Use	9 840	5 110	150	0
TOTAL LIVELIHOOD CONTRIBUTION	**11 500**	**8 300**	**84 680**	**22 380**

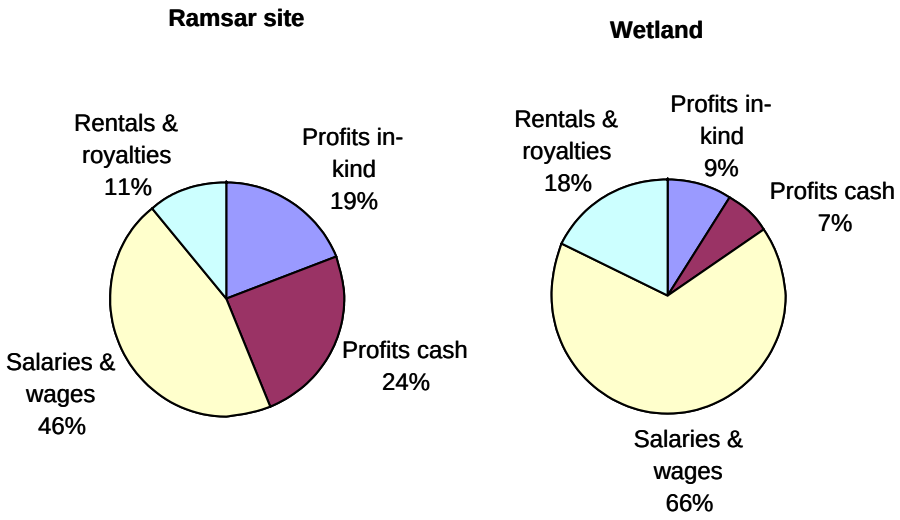

Figure 8-1. Relative contribution of different sources of natural resource-related income to poor households

Since much of the agricultural and natural resource harvesting/processing pursuits carried out by local households takes place in dryland parts of the Ramsar site, outside of the actual wetland, the contribution of the wetland to household livelihoods is overwhelmingly dominated by tourism salaries, wages and rentals/royalties.

8.3 Macroeconomic impact

Using our Ramsar site SAM model and the mathematical model described in Appendix 5, the impact of economic activities in the Okavango Delta on the national economy was calculated for two scenarios: one associated with the entire RAMSAR site and one restricted to the wetlands only, as explained above.

Table 8.4 shows the total impact of Okavango Delta activities on the Botswana's national income as measured by the Central Statistic Office (2006): the *direct* contribution to GNP is P475 million for the entire RAMSAR site and P380 million for the wetlands alone, roughly 1.04% and 0.84% of national GNP in 2005. But the *total* contribution to GNP is much higher: total income generated ranged was P1 182 million and P964 million, respectively, or 2.6% and 2.1% of national GNP. The GNP multiplier - the indirect stimulus from Delta activities to the rest of the economy - is roughly 2.5 (slightly higher for the wetlands). That means, for every P1.00 of income generated from direct services provided to tourists or agriculture, an additional P1.50 of income will be generated because of the demand for products to produce those services, and the products households buy with their additional income.

The GNP multipliers for household agricultural and natural resource harvesting/processing activities are 2.03 for the Ramsar site and 1.64 for the wetland. These are lower than those for tourism, because the household activities are mainly subsistence-based, with relatively small inputs from other sectors of the economy.

The total income shown in Table 8.4 is paid out to different 'factors of production,' that are necessary for production. These factors include skilled and unskilled labour, returns to capital invested in a business (gross operating surplus - GOS), rents for the use of traditional lands for tourism, taxes on production activities (including royalties to government agencies for use of government land) and taxes on products sold.[9] The distribution of income by factors is the first step toward understanding

[9] The taxes paid on production and products do not include income taxes, property taxes, or business profit taxes. These taxes are represented in another part of the model, as part of the expenditures of households and businesses. This is explained in Appendix 5.

how much income each household receives. Table 8.5 shows a summary of the distribution of income as it accrues to the factors of production.

Table 8-4. The total impact of direct use of the natural resources of the Ramsar site and the wetland on the national economy (P'000, 2005)

	Direct GNP	GNP multiplier	Total GNP
RAMSAR SITE			
Tourism	400,970	2.58	1,032,870
Agriculture/natural resource use	73,600	2.03	149,340
TOTAL	**474,570**		**1,182,210**
Percent of total national GNP	**1.04%**		**2.60%**
WETLAND			
Tourism	362,540	2.58	936,190
Agriculture/natural resource use	16,990	1.64	27,810
TOTAL	**379,530**		**964,000**
Percent of total national GNP	**0.84%**		**2.12%**

In Table 8.5 the payments to gross operating surplus for communities, and the payments to unskilled labour represent payments to the poor elements of society, and thus the contribution of the resource use activities towards poverty alleviation. These payments include the returns to investment by rural households, rentals/royalties paid to communities, and salaries and wages accruing to low income workers. They amount to 31% of direct income, and 18% of total income, for the Ramsar site, and 23% of direct income, and 14% of total income, for the wetland. The other payments in Table 8.5 accrue either to the formal sector or to government. They cover the formal sector costs of capital, including payments for investment in, and depreciation of, capital stock, and they also cover payments of profit tax and other taxes to government.

Table 8-5 Distribution of factor income from use of resources in the Ramsar site and wetland (P'000, 2005)

	Direct GNP	%	Total GNP	%
RAMSAR SITE				
Gross operating surplus communities	89,000	19%	89,000	8%
Unskilled labour	57,510	12%	118,060	10%
Gross operating surplus other	236,990	50%	727,710	62%
Skilled labour	82,920	17%	225,990	19%
Taxes on products	8,160	2%	21,460	2%
TOTAL	**474,570**	**100%**	**1,182,210**	**100%**
WETLAND				
Gross operating surplus communities	32,470	9%	32,470	3%
Unskilled labour	52,200	14%	102,020	11%
Gross operating surplus other	214,600	57%	616,570	64%
Skilled labour	74,860	20%	195,960	20%
Taxes on products	5,400	1%	16,980	2%
TOTAL	**379,530**	**100%**	**964,000**	**100%**

It is clear from Table 8.5 that the multiplier effect is greater for the formal sector than for the poorer components in society. This makes sense considering that the formal sector activities have greater backward linkages, and the community household activities (represented by the traditional agriculture sector in the SAM) tend to be primarily aimed at subsistence.

The SAM can also provide an indication of the degree to which the economic activities resulting from the use of the natural resource of the Okavango delta stimulate imports from other countries. Such information can be important in the formulation of policy to reduce dependence on imports, and there by increase the multiplier effects described above. In a small, open economy like Botswana, many goods and services are imported. Generally, imports do not benefit the domestic economy, because they represent demand for production in other countries.

Table 8.6 shows calculated import multipliers for economic activities in the Ramsar site and the wetland. The relatively high import multipliers, above 3, reflect the nature of the tourism industry. While the direct tourism purchases are of domestic services, a lot of the inputs for these services are imported. With the exception of petroleum products, it is likely that many of the imports are obtained from other countries in the region, especially South Africa. So, although the imports may not benefit Botswana, they may benefit the region. Further analysis of imported commodities and the origin of these imports would identify regional benefits from the Okavango Delta economy.

Table 8-6 Import multipliers for economic activities in the Ramsar site and wetland (P'million)

	Ramsar site	Wetland
Imports, direct	199	170
Imports, direct + indirect	669	551
Import multiplier	3.36	3.24

8.4 Natural asset value of the Okavango delta

Table 8.7 shows the results of the asset value calculation. Given the considerable uncertainty regarding future discount rates, it was necessary to conduct sensitivity analysis with these. The values differ considerably with different rates, but if, as seems likely, discount rates of around 6% will prevail, then the Ramsar site would have an asset value of some P3,9 billion, and the wetland would have an asset value of some P3.3 billion.

Table 8-7 The value of the Okavango delta as a natural capital asset (P'000, 2005)

	Discount rate	Asset value
RAMSAR SITE ASSET VALUE		
Land and wetland asset value @	2%	6,844,740
Land and wetland asset value @	4%	5,093,790
Land and wetland asset value @	**6%**	**3,915,630**
Land and wetland asset value @	8%	3,101,010
Land and wetland asset value @	10%	2,522,500
WETLAND ASSET VALUE		
Wetland asset value @	2%	5,928,390
Wetland asset value @	4%	4,408,840
Wetland asset value @	**6%**	**3,386,780**
Wetland asset value @	8%	2,680,390
Wetland asset value @	10%	2,178,980

9 IMPLICATIONS FOR FUTURE MANAGEMENT: A SCENARIO ANALYSIS

9.1 Introduction

While an understanding of the total economic value of the delta is potentially useful for lobbying for conservation support, consideration of how this value might change under different management or policy scenarios is potentially a far more useful undertaking for decision-makers. Numerous development options have been considered for this area in the past, such as irrigation schemes and water transfers out of the Okavango. Various management options have been considered which affect the location and extent of veterinary fences and wildlife management areas, or consumptive or non-consumptive use of wildlife, the density of tourism developments, etc. In addition, it would be prudent to consider the effect of matters beyond local control, namely climate change which threatens to alter rainfall patterns and flooding of the Okavango. This chapter considers a handful of feasible scenarios in order to investigate how the economic value of the Okavango Delta would be affected.

It should be emphasised that this entire study was carried out as a brief exercise where the main emphasis was on deriving the current value of the delta. This scenario analysis is purely a desktop analysis, and essentially a back-of-the-envelope exercise designed to explore the possible types of outcomes under different scenarios. Spatial data on values are not detailed enough to allow accurate calculation of scenario impacts. Thus estimates of biophysical changes that would lead to changes in economic value were made on the basis of educated subjective estimates made by team members. If these outcomes are of particular interest it would be worthwhile investigating the assumptions further in a dedicated study.

9.2 Description of selected scenarios

The scenarios considered here were developed based on scenarios that have already been considered for the delta at one stage or another, or that would illustrate an extreme case. The proposed scenarios were discussed in a stakeholder workshop during an early part of the study. The list of scenarios considered here is not comprehensive, however. For example, it has been argued that Moremi should be opened up to CBNRM to reduce conflicts between Khwai residents and the wildlife tourism sector, since the establishment of Moremi ain 1963 led to displacement of Khwai residents from their land ,and affected the Basarwa's hunting and gathering economy (Mbaiwa 2005). We have not considered such a scenario.

The present situation is described in detail in Chapter 2. The following potential future scenarios were investigated, each of which is described in more detail below:

1. Agricultural expansion
2. Expanded protection
3. Wise use
4. Wise use plus abstraction
5. Wise use plus climate change

The planning document by Plantec *et al*. (2006) was used to guide the wise use scenarios.

9.3 Description of selected scenarios

9.3.1 Scenario 1. Agricultural expansion

In this scenario the veterinary fence is moved back and grazing is expanded into the wetland area. Existing photographic tourism activities in and around Moremi continue and expand into a buffer area around the reserve, replacing commercial hunting to the west of the reserve. Commercial and communal hunting activities are precluded in the expanded grazing area.

This may be somewhat different from Plantec *et al*.'s (2006) Option 1, in which land use is driven by comparative advantage of the different resources. The latter did not explicitly include shifting the veterinary fence, although it considered options for expanding economic growth without being hindered by current legislative constraints. Plantec *et al*.'s (2006) Option 1 basically follows existing land use in the Ramsar site, but emphasises the use of the rich natural resource base of the area in zoning land for various land use activities, with emphasis on economic growth.

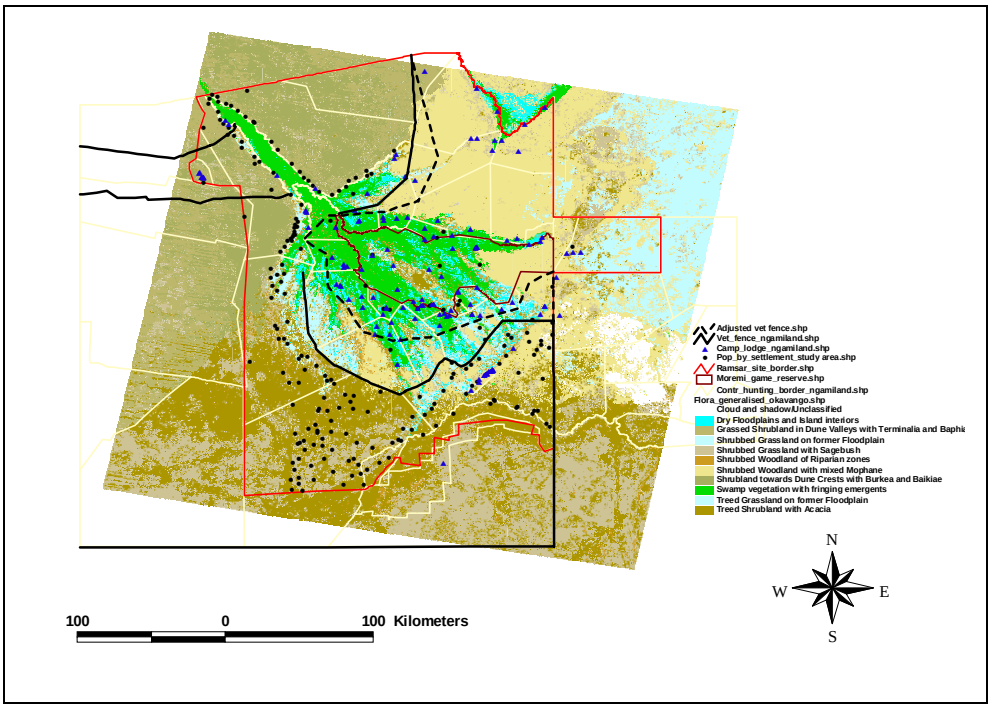

Figure 9-1. Change in position of the veterinary fences under Scenario 1. Expanded agriculture

9.3.2 Scenario 2. Expanded protection

This scenario places emphasis on the conservation of the Ramsar site, with particular emphasis on the delta wetlands as the most sensitive area. The **delta wetland** area, is proclaimed as a **national park**, but lodges are located both within and around the park as at present. The main difference from present is that there is no consumptive use of resources (e.g. reed collection, fishing or hunting) within the national park. Throughout the rest of the Ramsar site, use of natural resources will be controlled at sustainable levels.

In Scenario 2b, we consider no hunting throughout the Ramsar site.

Note that this is somewhat different from the rather unlikely scenario presented as Option 2 in Plantec *et al*. 2006, in which the extreme conservation scenario involves no consumptive use throughout the Ramsar site, and all lodges within the delta wetland area being moved to the periphery.

9.3.3 Scenario 3. Wise use

This scenario is based on the land use plan as recommended by Plantec *et al*. 2006. This is largely based on the Ramsar planning guidelines for wetland ecosystems. Emphasis is on sustainable resource use, such that utilisation is within the regeneration capacity of resources and does not alter the ecological balance of the delta. Land uses in ecologically vulnerable areas, such as molapo farming and resource harvesting, would be subject to more intensive management, monitoring and enforcement. Existing lodges would continue, but new ones would only be allowed if this is within the carrying capacity of the delta. We assume that new photographic lodges are established in the buffer zone to the west of Moremi. There is emphasis on balancing the need for protection and tourism use, and the avoidance of disruption of livelihood strategies.

The main differences from present are:

- Part of the commercial and community wildlife utilisation areas are zoned for commercial and community photographic areas, in order to create a buffer around Moremi;
- The northern-most controlled hunting area is changed from undesignated to community managed photographic area;
- A tourism development area is proposed alongside the wetland below the panhandle in the Etsha area; and
- Within Moremi, tourism use is zoned into low and medium density and wilderness zone.

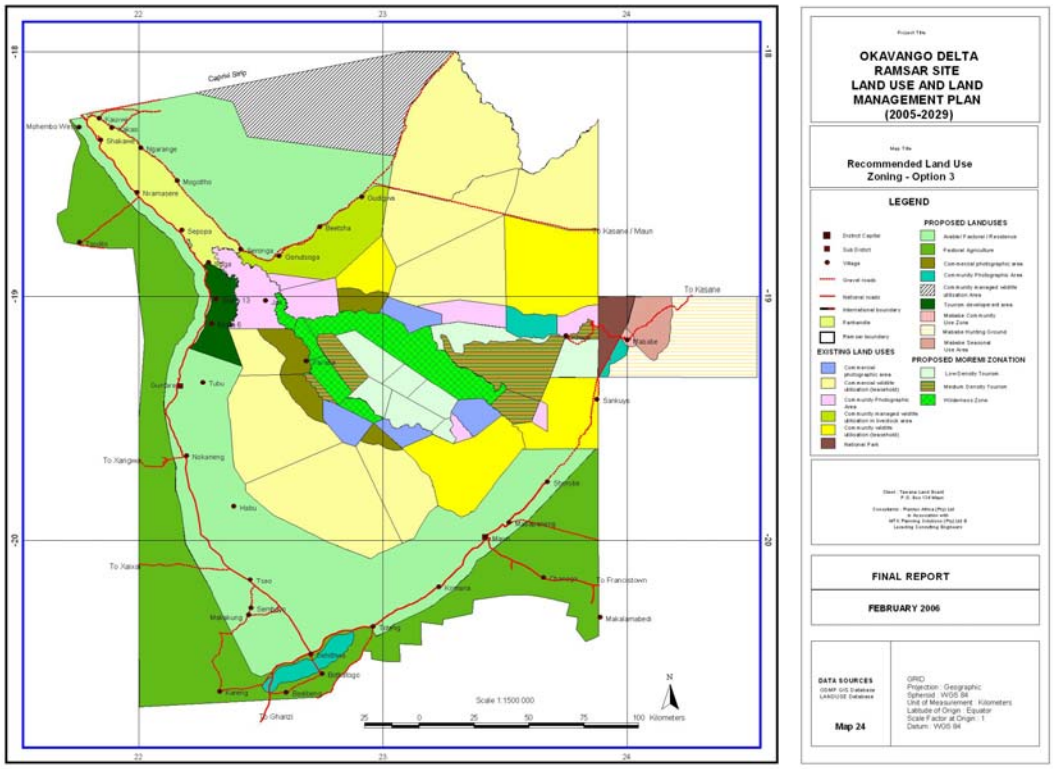

Figure 9-2. Land use under Scenario 3. Wise Use

9.3.4 Scenario 4. Wise use *plus* upstream abstraction

Extreme hydrological development upstream (Angola dams, irrigation in Nam, and delta abstraction)

This scenario is based on the wise use scenario plus upstream water resources development as described in Scanagri *et al*. (December 2005). The water resources developments are as follows:

- Development of ten dams for hydropower in Angola, changing the distribution of flow and altering sedimentation into the delta;
- Irrigated area of 54 500 ha in Angola and 7500 ha Namibia, creating an irrigation demand of 15 000 m^3/ha/annum;
- Abstractions of surface water in the Delta for domestic supply, livestock, small scale irrigation and construction. The modelled amount is a total abstraction of 68 000 m^3/day, as the projected demand in 2025 (current use is about 46 540 m3/day; Scanagri *et al*. 2005).

Scanagri *et al*. (2005) predicted the impacts on flow based on the above scenarios, and how these would affect the areas of five types flood area ranging from permanently flooded to rarely flooded areas (Figure 9-3). Note that the rarely flooded area includes large parts of what is woodland today. The delta wetland area can be considered as the first four areas, but it should be noted that molapos and some minor wetlands and floodplain areas are situated in the fifth zone.

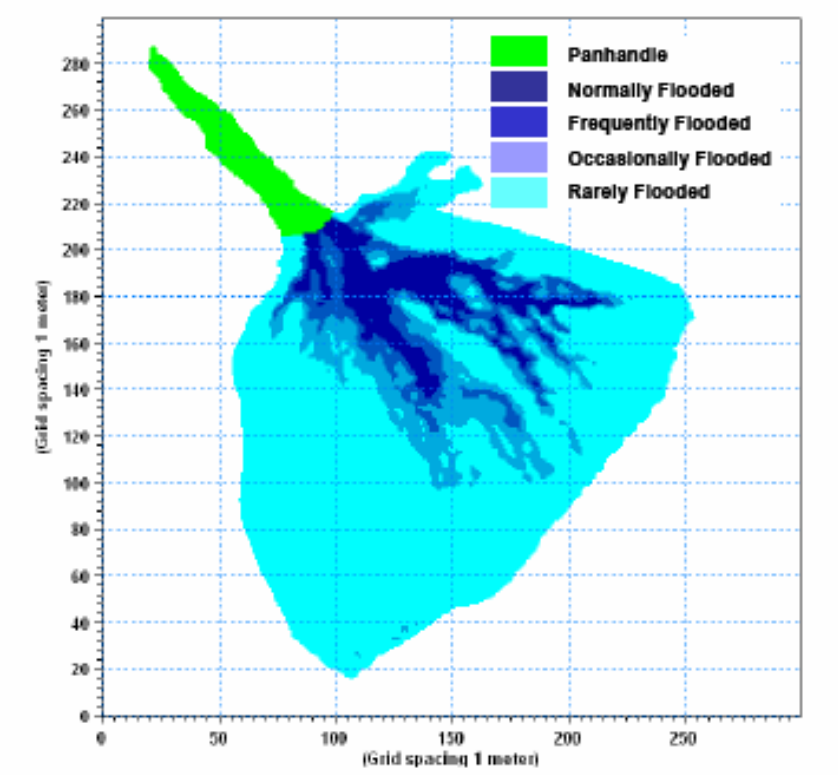

Figure 9-3 Different categories of flooding area in the Okavango Delta (Scanagri *et al*. 2005)

We used the average results over the three periods predicted by Scanagri *et al*. (2005). Under the abstraction scenario, the delta proper is reduced in area by 10%. This reduction is fairly uniform across the different flood zones (Figure 9-4).

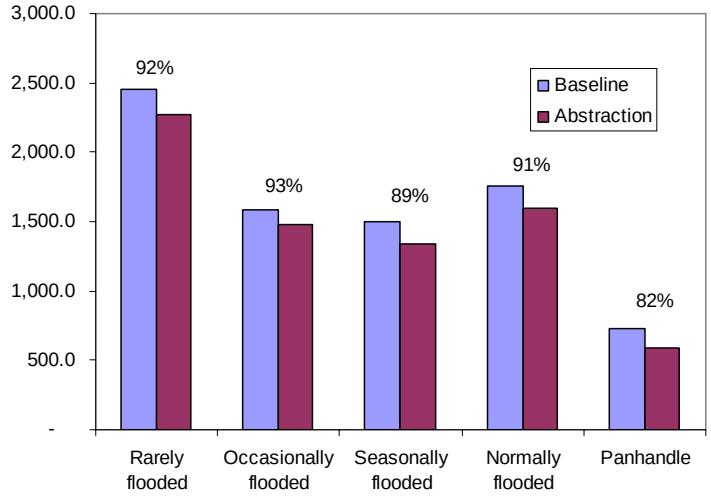

Figure 9-4. Predicted change in area for each of the types of flooding area in the Delta under a water abstraction scenario (based on Scanagri *et al*. 2005)

9.3.5 Scenario 5. Wise use *plus* climate change

Climate change is likely to have an impact on the delta due to its effects on catchment and local rainfall. Several climatic models have been built to predict the impacts of climate change, but their predictions vary greatly depending on the assumptions made, among other considerations. One of the most widely accepted models is the HadCM3. Scanagri *et al*. (2005) used the predictions of changed precipitation and temperature under this model to modify the flows into the delta for the year 2025. The result was a highly significant change in runoff and flooding of the delta, with inflows being reduced by 38% and local precipitation by 9%. These effects are compounded by a temperature increase of 2.2°C.

Under this scenario, the delta proper is reduced in area to 65% of its current size. The more occasionally flooded areas are the most impacted, but even the Panhandle is greatly affected (Figure 9-5).

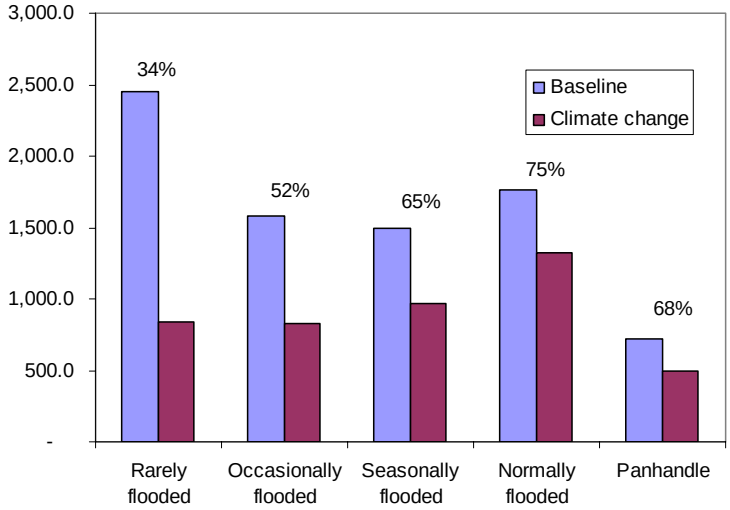

Figure 9-5. Predicted change in area for each of the types of flooding area in the Delta under a climate change scenario (based on Scanagri *et al*. 2005)

9.4 Parameters under different scenarios

In the absence of an ecological model of the delta, the hydrological model results were used to guide estimates of the changes in various biophysical parameters under the different scenarios, in conjunction with the expected change in land use under each scenario (Table 9-1). These estimates are rough and require further investigation, but are probably sufficiently indicative to allow a reliable ranking of the scenarios.

Table 9-1. Estimated percentage relative to present for different parameters under the five scenarios

Scenario	**1. Agriculture**	**2. Protection**	**3. Wise use**	**4. Abstraction**	**5. Climate ch.**
External factors:	*Present*	*Present*	*Present*	*Abstraction*	*Climate change*
Land Use:	*Development*	*Protection*	*Wise use*	*Wise use*	*Wise use*
Surface water supply	100	100	100	90	68
Grazing resources	120	70	100	90	68
Area of molapos	110	97.5	100	92	34
Fish stocks	100	85	90	90	65
Wetland grass stocks	80	90	110	90	65
Reed and sedge stocks	80	90	110	90	65
Delta area mammals	80	90	110	90	65
Wetland birds	80	90	110	90	65
Wetland food plants	80	90	110	90	65
Non-consumptive tourism	100	120	120	100	80
Hunting tourism	60	0	75	70	50
Groundwater supply m^3	100	100	100	90	50
Carbon sink	100	100	100	100	110
Wildlife refuge	75	110	110	90	65
Water purification	100	100	100	95	65
Scientific/education value	90	100	100	95	80
Option value	Medium	V high	High	Medium	Low
Existence value	Medium	V high	High	Medium	Low

9.5 Economic implications of different scenarios

The economic implications are described in Table 9.2 and Figure 9-6, in terms of expected changes in direct value added from the Ramsar Site and the wetland itself. In estimating the impacts, the proportion of different types of value that are attributable to the wetland were taken into account, as well as the extent to which the value would be affected under the different scenarios.

With no change in external factors, the most favourable scenario in terms of direct use values is the Wise Use scenario (3), This suggest that current land use plans are optimal, and more economically efficient than options which give more emphasis to conservation and agricultural expansion. It illustrates the complementary nature of current land use in the delta. The values for the Wise Use Scenario are compromised somewhat under the Abstraction scenario (4) and severely under the Climate Change (5) scenario (Table 9-2). Indeed the values for the less desirable scenarios (1 and 2) would be similarly affected. In reality the impacts resulting from external factors in scenarios 4 and 5 impacts might be mitigated to some extent by adaptation.

The impacts of the scenarios on the indirect use values (ecological service values) estimated in this study are difficult to quantify and these values have been given ratings only. The Protection and Wise Use scenarios would appear to result in the highest values. The values would again be reduced under the effects of external factors such as abstraction and Climate Change. While non-use values such as

existence value are unknown, it is reasonable to assume that they are correlated with biodiversity. Thus the Protection scenario is likely to rate highest in terms of existence value. The Climate Change scenario will have the greatest impact on this value.

Table 9-2 Estimated outcomes in terms of direct value added, or general value, attributable to the Ramsar Site and the wetland, following five different scenarios. Note that estimates are rough.

Scenario	Present	1. Agriculture	2. Protection	3. Wise use	4. Abstraction	5. Climate change
Ramsar site						
Tourism	514 100 000	471 100 000	487 920 000	**568 545 000**	481 850 000	379 030 000
Household use	70 231 769	70 532 221	57 520 039	**70 629 294**	68 297 910	63 181 679
Indirect use	High	High	V high	**V high**	Medium	Low
Existence	High	Medium	V high	**High**	Medium	Low
Wetland						
Tourism	461 520 000	431 420 000	463 524 000	**519 961 500**	438 945 000	346 641 000
Household use	18 989 980	17 936 907	8 189 818	**19 389 135**	17 753 028	14 484 703
Indirect use	High	High	V high	**V high**	Medium	Low
Existence	High	Medium	V high	**High**	Medium	Low

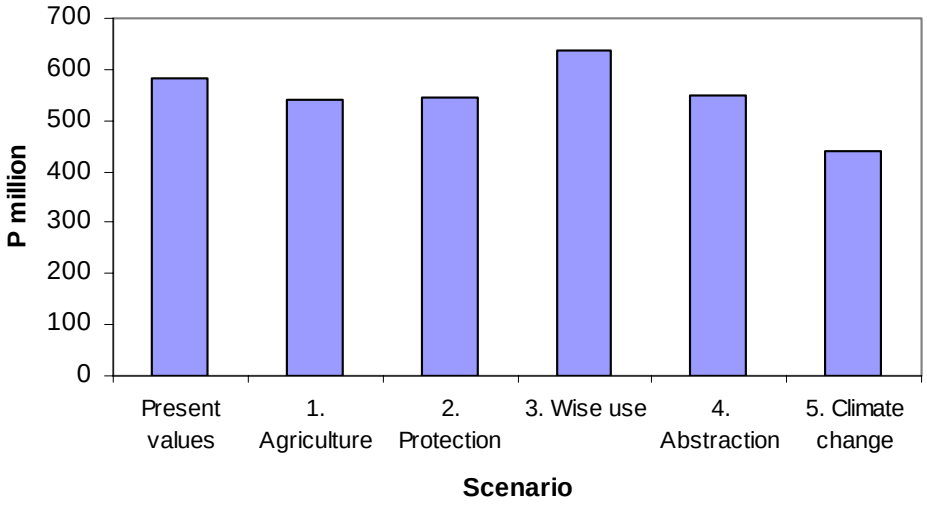

Figure 9-6. Overall outcomes of the different scenarios.

10 CONCLUSIONS AND RECOMMENDATIONS

This study has attempted to value the Okavango Delta and the Ramsar site as a whole within the context of total economic value which includes direct use values, indirect use (or ecological services) values, option and non-use values. Option and non-use values have not been included in this analysis for budgetary and time reasons. The values are made with the intention that they should be, as far as possible, compatible with the national accounts of Botswana and the natural resource accounting procedures being practised by the Department of Environmental Affairs. Values have also been made for the whole Ramsar site, which includes some surrounding drylands as well as the delta wetlands, as well as for just the wetlands component of the site (i.e. Okavango Delta). Values are estimated for 2005 in Pula, which at the time was worth US$0.19.

Direct use values associated with the Okavango Delta Ramsar site include those generated by non-consumptive tourism, hunting tourism, household livestock production, household crop production, and household harvesting and processing of natural resource products. The values are overwhelmingly dominated by those generated by tourism, which takes place in the central zone, and which contributes P401 million annually to the GNP. Eighty percent of the tourism direct value is from non-consumptive activities. Ninety percent of tourism is attributable to the actual wetland within the Ramsar site,

Agricultural pursuits take place mainly in the northern, western and southern zones, and contribute P42 million annually to the GNP. Ninety three percent of this is from livestock, and only 3% of it is derived from the wetland itself. Household harvesting and processing of natural resources also takes place in the north west and south, and contributes P29 million annually to GNP. Fifty three percent of this derived from the wetland.

Indirect use values or ecosystem services in the form of carbon sequestration, groundwater recharge, water purification, wildlife refuge functions and provision of scientific and educational value, are provided by the Ramsar site. These were estimated to amount to some P230 million, dominated by the carbon sequestration and wildlife refuge functions. The indirect use value of the delta is estimated to be P199 million. Estimates for these values are difficult to make and are thus fairly uncertain.

As stated, option and non-use values were excluded from the study. Given the high profile of the Okavango delta, these values are expected to be very high internationally. These values require specific study. With appropriate market mechanisms, they could be captured to contribute significantly to Botswana's income. Planning for the delta needs to ensure that these values are preserved.

The direct use values generated by the Ramsar site also have a wider impact on Botswana's economy through the multiplier. A modified social accounting matrix (SAM) model of the Botswana economy was used to determine that for every P1.00 that direct uses contribute to the GNP, another P1.50 in GNP contribution is generated in the wider economy through demand created in backward linkages. Thus, the Ramsar site has a total annual impact on the GNP amounting to P1.2 billion, or 2.6% of the total national GNP. Eighty one percent of this total impact is contributed by the wetland. The multiplier effect is higher for formal tourism sector activities than for household agriculture and natural resource use. However, policies aimed at reducing the fairly high import component of tourism linkages, might increase the multiplier effects.

The Ramsar site contributes to livelihoods of its people through profits (both cash and in-kind) from agricultural and natural resource use, through wages and salaries in the tourism sector and from rentals and royalties in the tourism sector. Poor households in the study area benefit from profits amounting to P99 million, from wages and salaries amounting to P102 million, and from rentals and royalties amounting to an estimated P25 million. The wetland contributes less than 3% of profits, but nearly all the wages and royalty benefits. Of the direct contribution made to the national GNP by the Ramsar site (P472 million per annum) 31% accrues to low income elements of society. In the total (both direct and indirect) contribution made to the national GNP by the Ramsar site, this figure is lower, being some 18%.

In the natural resource accounting framework, the Ramsar site and the wetland were treated in the form of land or ecosystem accounts. The direct use values measured in this study represent the production or flow accounts. The asset value, measured as the 2005 value of the expected future flow of resource rents from the land, was estimated at P3.9 billion for the Ramsar site and P3.4 billion for the wetland.

We examined the likely effects of three future land use options on the direct use values. These involved the currently proposed land use plan, a second option where the emphasis was put on the expansion of agricultural lands, and a third option where the emphasis was put on protection of the natural assets of the delta. The currently proposed land use plan, which gives emphasis to complementary land use and wise use of the resources, emerged as the most economically efficient. This plan thus appears optimal for the Ramsar site. The likely effects of external factors, involving water extraction plans and climate change predictions were tested in two further scenarios. These factors, particularly climate change, will reduce the value of the Ramsar site. Attention should be given in planning to any possible ways of ameliorating these effects.

Management of the Okavango Delta and the Ramsar Site in general will need to strike a balance between meeting the needs of the people living in and around the delta and generating its important contribution to the national economy. People living in the study area derive roughly equal benefits from natural resources and from tourism, the latter being slightly higher. However, there is an important difference in the form that these benefits take. Natural resources provide subsistence value which contributes to peoples' livelihoods, as well as some cash income. Perhaps more importantly, they have the capacity to provide a safety-net for households that suffer shocks and provide a risk-spreading mechanism for poor households that are vulnerable to the vagaries of environmental variability. Tourism, on the other hand, generates hard, reliable cash income to households, providing the type of income that most households aspire to having. Thus both aspects are important. Tourism also makes a substantial contribution to Botswana's GNP, which in turn provides more revenue and social security to households all over the country. In the light of the above findings, it is recommended that future management of the Okavango Delta is centred on ensuring the sustainability of current resource use by households so that they can continue to provide the livelihood and other social benefits into the future, and enhancing the value of the delta for low impact – high value tourism through maintaining the extent and integrity of the conserved area. The enormous value of tourism in the Okavango Delta could be turned to greater advantage if policy aimed to reduce the import component of tourism and to expand the links between tourism and development through CBNRM. Given the massive potential influence of changes in freshwater inflow into the delta on the capacity to generate both household and tourism benefits, and the potential effects of climate change in exacerbating any impacts of upstream water abstraction, it is essential that Botswana works to ensure adequate flows in future through international agreements.

Finally, we recommend that there is ongoing research on ecosystem functioning of the delta that will be able to inform our understanding of the value of ecosystem services and the impacts of finer scale management decisions. Research is needed on tourism in order to understand the mechanisms of demand and supply and the impacts of various policy decisions. In addition, more research is required on the non-use value generated by the delta in order to appreciate the impact of changes in ecosystem health of the delta on the international community.

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12 GLOSSARY

Abstraction – pumping water from a borehole or surface water body

Allocate – to award a certain quantity of a 'resource' (such a land or water) to various users or to different uses.

Aquifer – a reserve of water underground. The 'aquifer' is in fact spaces between grains of sand or in cracks or cavities within rock that are filled with water.

Biodiversity – the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within and among species and diversity within and among ecosystems.

Carbon sequestration – the process of capturing carbon and keeping it from entering the atmosphere for some period. Carbon is sequestered in carbon sinks, such as forests, soils or oceans.

Carrying capacity – a biological term that indicates the ability or capacity of an area to support or 'carry' plant and animal life. In human terms it is the number of people that can be supported by an area.

Catchment – the area that receives or 'catches' the rain that flows into a particular river

Consumer surplus – a net benefit realised by consumers when they buy a good at the prevailing market price. It is the difference between the maximum price consumers would be willing to pay and that which they actually pay for the units of the good purchased.

Contingent valuation – the use of questionnaires about valuation to estimate the willingness of respondents to pay for public projects or programmes

Molapo – a grass-covered depression that fills with water during the wet season. Also called a '*dambo'*.

Delta – the area where a river approaches the seas or inland depression, spreads out and branches, and deposits most of its sediment load.

Direct use value: - within the 'total economic value framework', the benefits derived from the goods and services provided by an 'ecosystem' that are used directly by an economic agent. These include consumptive uses (e.g. harvesting goods) and non-consumptive uses (e.g. enjoyment of scenic beauty).

Discount rate - the interest rate at which future payments or income are discounted in a multi-period model. Reflects the time preference between consumption or income now or in the future.

Discounting – the process of applying a 'discount rate'. The rate of interest to cost and benefit flows that is used to find the equivalent value today of sums receivable or payable in the future.

Diversity – the total number of different organisms or species found in an area.

Economic growth – the percentage change in the 'national income', resulting from investment, increases in trade, size or scale effects, or technological progress.

Ecosystem – all the living organisms and the physical environment in an area, as well as all the processes that link them together.

Ecosystem function – an intrinsic 'ecosystem' characteristic related to the existence of conditions and processes whereby an ecosystem maintains its integrity, such as primary productivity, predation, decomposition, nutrient cycling.

Ecosystem services – the benefits people obtain from 'ecosystems', including provisioning of food and water, regulation of disease and flooding, spiritual, recreational and cultural benefits.

Effluent – polluted waste water that comes from an industrial processs or sewage system

Endemic – a species native to a specific location and occurring nowhere else

Eutrophication – the excessive growth of water pants, usually algae, due to an excess of nutrients.

Evapotranspiration – loss of water through evaporation and transpiration.

Existence value - the value that individuals may attach to the mere knowledge of the existence of something, as opposed to having direct use thereof. Synonymous with non-use value.

Exports - goods or services produced in one country and sold or consumed in another.

Flow accounts - Used here to refer to production accounts in 'natural resource accounts', valued in terms of annual contribution to national income.

Gillnet – a type of fishing net that catches fish at their gills as they swim through it.

Gross domestic product (GDP) – the measure of total 'value added' (total value of all the goods and services produced in an economy, less raw materials, and other goods and services used in

the production process) in all resident producing units, during some accounting period, usually a year. See 'national income'.

Gross fixed capital formation (GFCF) - the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period, usually a year. Conventionally excludes natural assets which are not man-made and/or owned.

Gross income - 'Gross revenue', 'turnover', usually a private measure.

Gross national product (GNP) - the same as GNP except that it includes income earned abroad by nationals, and excludes income transferred abroad by foreign owners. See 'national income'.

Gross national income (GNI) - the measure of the income earned, whether domestically or abroad, by factors of production owned by residents. See 'national income'.

Gross operating surplus - that part of 'value added' that is not payments for labour or taxes on production.

Gross output - 'gross revenue' in economic terms, commonly the aggregate of all gross revenues in the economy.

Gross revenue – in general terms, equal to the unit price multiplied by the quantity of units sold by a production unit. Here used as a private value.

Imports - goods or services consumed in one country which have been brought from another country.

Indirect use value – the benefits derived from the goods and services provided by an ecosystem that are used indirectly by an economic agent. For example and agent at some distance from an ecosystem may derive benefits from drinking water that has been purified as it passed through the ecosystem.

Multiplier - the amount by which equilibrium output of the economy changes when aggregate demand – as caused for example by the expenditure by a development project – increases by one unit. As those receiving the initial round of income generated are likely to consume a portion of the additional income, this subsequent expenditure will lead to additional ripple effects of rounds of income and consumption throughout the economy. The net effect of these increases in output is the multiplier effect of the initial expenditure, measured as a proportion of the initial expenditure. Multipliers can be measured with respect to income, value added, imports, production, etc.

National accounts – the compilation of accounts to derive estimates of the 'national income'.

National income - the total net earnings of labour and property employed in the production of goods and services in a nation during some accounting period, usually year. Broadly defined commonly measured by the 'gross domestic product' (GDP) the 'gross national product' (GNP), and the 'gross national income' (GNI). Measured either as the value of all expenditure on final goods and services, the value of all payments to factors of production, or the value of all value added by producing units.

Natural asset value – capital value of the stock of a natural resource. This is the present value of the stream of future 'economic rents' ('resource rents') that a natural resource will generate. Present values are typically obtained by 'discounting' future benefits and costs.

Natural resource accounts - the compilation of asset and 'flow accounts' for natural assets, to complement the 'national accounts'. Asset accounts are valued in terms of 'natural asset value', flow accounts are valued in terms of 'national income'.

Net income - 'profit', a private value.

Net national income - 'Gross national income' less depreciation of assets.

Net present value – the present value of an investment, found by 'discounting' all current and future streams of income or expenditure by a 'discount rate'.

Non-use value – see ‘existence value’

Open access resource – a good or service over which no property rights are recognised.

Opportunity cost – the benefits foregone by undertaking one activity instead of another

Option value – the value of preserving the option to use services in the future.

Precautionary approach - according to the Rio Declaration on Environment and Development (1992) where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Private costs and benefits – costs and benefits directly felt by individual economic agents or groups as seen from their perspective. Costs and benefits are valued at the prices actually paid or received by the group, even if those prices are highly distorted. Sometimes termed ‘financial’ costs and benefits.

Production unit - an entity engaged in a productive activity, here describing an enterprise, commonly a household or a firm.

Profit - the difference between 'gross revenue' generated in a production unit and the costs of production. Used here as a private accounting measure.

Ramsar Convention – The convention for the Conservation of Wetlands of International Importance, Especially as Waterfowl Habitat, also called 'the wetland treaty'. It is named after a town in Iran where the agreement was first drawn up.

Recession agriculture - a system of agriculture that depends on the moisture of the soil as the flood recedes. It takes place in floodplains, where flooding is seasonal.

Resource – something that can be used. Natural resources include things like water, wood, minerals. Human resources refer to the skills and capabilities that people have.

Resource rent or **economic rent** - the return a factor of production receives in excess of the minimum required to bring forth the service of the factor, or the surplus available in a 'production unit' after accounting for the costs of production including a reasonable return to capital. Resource rent is the economic rent generated from use of a natural resource.

Scenario – a plausible and often simplified description of how the future may develop, based on a a coherent and internally consistent set of assumptions about key driving forces and relationships. Scenarios are neither predictions nor projections.

Social accounting matrix (SAM) - an economic input-output model of the national economy, used as a tool for impact analysis. Expands the national accounts to show the linkages between production and generation of income and distribution of income

Social costs and benefits – costs and benefits as seen from the perspective of society as a whole. These differ from private costs and benefits in being more inclusive (all costs and benefits borne by some member of society are taken into account) and in being valued at social opportunity cost rather than market prices, where these differ. Sometimes termed 'economic' costs and benefits.

Sustainable – something that can carry on indefinitely.

Sustainable development – development that can support people now and carry on supporting people for a long time into the future, without having effects that threaten the livelihoods of future generations

Swamp – a marsh or waterlogged, well vegetated 'wetland'.

Total economic value framework – a widely used framework to disaggregate the components of utilitarian value, including 'direct' and 'indirect use value', 'option value' and 'existence value'. Commonly applied to natural resources.

Turnover – 'gross revenue', 'gross income'.

Value added - the amount of economic value generated by the activity carried on within each 'production unit' in the economy, the difference between the 'gross revenue' of the production unit and the inputs purchased from outside the production unit. When aggregated for the whole economy becomes a measure of 'national income'.

Wetland – an area where the soil is continually wet or under water for long periods.

13 APPENDIX 1. ITINERARY FOR FOCUS GROUP AND HOUSEHOLD SURVEYS

Date	Time	Site	Activity
19 Feb - Sunday	1.00pm	Shakawe-A1	-Travel from Maun to Drotsky Camp -Meeting with key informant –Commercial fishing
20 Feb			Focus Group Discussions 8.30 Meeting with Elders 9.30 Fishers 10.30 Livestock Farmers 11.30 Crop Farmers 12.30 Natural Resource Users
21 Feb- Tuesday	8.00 am		Travel back to Maun
25 Feb-Saturday	9.00 am	Shakawe-A1	Travel from Maun and camp at Shakawe
26 Feb- Sunday	9.00 am	Ngarange-A1	-Introduce Team to Elders -Household surveys
27 Feb- Monday	8.30 am	Shakawe-A1	-Introduce Team to Elders -Household surveys
28 Feb- Tuesday	9.00 am	Gumare-A2 Jao-A2	-Household survey (Jao) - Travel and Camp - Meeting with Elders
1 March -Wednesday	8.30 am	Gumare-A2	- Focus Group Discussions 8.30 - Livestock Farmers 10.30- Crop Farmers 11.30- Natural Resources Users - 8.30 Household Surveys - Camp in Nokaneng
2 March - Thursday	8.30 am	Nokaneng-A2	-Introduce Team to Elders -Household surveys
3 March- Friday	8.00 am	Sehithwa-A3	- Travel and Camp - Meeting with Elders
4 March -Saturday	8.30 am	Sehithwa-A3	- Focus Group Discussions 8.30 - Livestock Farmers 10.30- Crop Farmers 11.30- Natural Resources Users - 8.30 am Household Surveys
5 March -Sundays	8.30 am	Toteng- A3	-Introduce Team to Elders -Household surveys Back to Maun
6 March - Monday	8.30 am	Sankuyu	Focus Group Discussions 8.30 Meeting with Elders 9.30 Livestock Farmers 10.30 Crop Farmers 11.30 Natural Resource Users - 8.30 am Household Surveys
7 March Tuesday	8.30 am	Shorobe	Introduce Team to Elders - Household surveys
8 March - Tuesday	8.30 am	Maun	- Focus Group Discussions 8.30 Meeting with Elders 9.30 Livestock Farmers 10.30 Crop Farmers 11.30 Natural Resource Users Introduce Team to Elders -Household surveys

14 APPENDIX 2. TOURISM OPERATIONS IN THE OKAVANGO DELTA

HOTELS

1 Rileys Hotel
2 Sedia Hotel

GUEST HOUSES

1 Alfa Go Tia Alfa Lodge
2 Botshelo Guest House/Spyra
3 Discovery Bed & Breakfast
4 Dreadnought Investment - Kigiso G/H
5 Lethaka Cabins
6 Maduo Guest House
7 Marina's Backpackers
8 Matsaudi Guest House
9 Maun Lodge

CAMPS

1 Abercrombie and Kent t/a Piajo
2 Abercrombie and Kent t/a Piajo Chief's Island
3 African Field and Sports T/A Joverega
4 African Field and Sports T/A Mababe
5 African Field and Sports T/A Mogotlo
6 African Horseback Safaris (Burnbury)
7 Antique Africa Holdings t/a Crocodile camp
8 Audi Camp
9 Bird Safaris - Splash
10 Bird Safaris - Tsum Tsum
11 Bukakhwe Cultural (Gudigwa)
12 Cgaecgae Tlhabololo Trust
13 Conservation Corporation Botswana/Southern
14 Crocodile Camp Safaris
15 Desert & Delta - Savuti Safari Lodge
16 Desert & Delta - Camp Moremi
17 Destination South - Tenunga
18 Elephant Back Safaris - Abu Camp
19 Elephant Back Safaris - Selby's ng26
20 Flamingo Investments - Chitabe
21 Game Trackers - Khwai River Lodge
22 Game Trackers - Savuti Elephant Lodge
23 Game Trackers - Xaxaba Camp/Eagle Island
24 Great Explorations - Xigera Camp
25 Guma Island Lodge
26 Gunn's Camp
27 Heart & Soul - Pompom Camp
28 Island Safari Lodge
29 Johan Calitz Hunting Safaris - Stanleys Camp
30 Johan Calitz Hunting Safaris - Namakusi Camp
31 Johan Calitz Hunting Safaris - Savory Camp
32 Johan Calitz Hunting Safaris - Sigonkwe
33 Johan Calitz Hunting safaris T/A Baines
34 Ker & Downey - Machaba Camp ng19
35 Kgori Safaris ng43/Kwatale
36 Komtsa Adventure Safaris
37 Kwando Kwara Camp ng20
38 Kwando Lagoon Camp
39 Kwando Lebala Camp ng14
40 Letsatsi Safaris & Lodge
41 Linyanti Investments - Sable Safaris
42 Linyanti Investments - Dumatau
43 Linyanti Investments - Savuti
44 Linyanti Investments T/A Tented Camp
45 Linyanti Investments - Kings Pool
46 Lloyds Camp t/a Savuti Safari Lodge-Desert & Delta
47 Lodges of Botswana - Delta Camp
48 Lodges of Botswana - Oddballs
49 Macanteer Photo CCCamp - Safari South
50 Modumo K & M Safaris & Lodge
51 Moremi Safaris and Tours
52 Nemesis - Masame Camp
53 Ngamiland Adventure - Jao
54 Ngamiland Adventure - Jacana
55 Ngamiland Adventure - Kwetsani
56 Ngamiland Adventure Safaris - Tubu Tree
57 Okavango Dev. Safari South Xudom Camp ng29
58 Okavango Dev./Safari South Macateer camp
59 Okavango Fishing Safaris/Shakawe lodge
60 Okavango Horse Safaris - Kuwana
61 Okavango River Lodge
62 Okavango Wilderness - Duba
63 Okavango Wilderness - Linyanti
64 Okavango Wilderness - Little Vumbura
65 Okavango Wilderness - Vumbura

66 Okavango Wilderness SAFA Mombo
67 Okuti Safaris/Camp Okuti
68 Penduka
69 Rann Hunting Safaris - Gubanare camp
70 Rann Hunting Safaris - Sahile Camp
71 Rann Hunting Safaris - Ranns Camp
72 Rann Hunting Safaris - Kiri Camp
73 Rising With The Sun Safaris
74 SE Contractors T/A SE Game Ranching
75 Safari Botswana Bound
76 Sankuyo Tswaragano Man. Trust/Santawani
77 Sankuyo Tswaragano Man. Trust/Kazikili
78 Sankuyo Tswaragano Man. Trust/Sahandeteka
79 Sepopa Swamp Stop Fishing Camp
80 Seteba Weila Signs
81 Slow But Sure
82 Southern Quest - Chitabe North
83 Squacco Heron Projects T/A Wildscenes
84 Tenacia Enterprises t/a Starling
85 Thamalakane Properties T/A Maun R
86 The African Safaris Company
87 Wagon Wheel Farm
88 Wagon Wheel T/A Motsentsele Lodge
89 Xakanaka Camp - Moremi Safaris
90 Xaxaba Camp T/A Game Trackers
91 Xugana Island Lodge T/A Desert and Delta
92 Xyga Fishing Resort
93 Okavango Dev. Safari South Mastsebe Camp

MOBILE SAFARIS

1 Afro Trek
2 Bahati Safaris
3 BK & Nande (Pty) Ltd
4 Botswana Safaris and Tours
5 Brigade Safaris (Pty) Ltd
6 Bush Camp Safaris
7 Bush Travellers
8 Bushlife Safaris
9 Camel Ride Safaris
10 Capricorn Safaris
11 Capture Africa
12 Chanduga Safaris
13 Custro's Safaris (PTY) Ltd
14 Daphne Wilmot Safaris
15 Dave Baker Exclusive Safaris/Northward Holdings
16 Davey's Enterprises
17 David Goliath T/A Kalahari Kavango
18 Delta Cruisers
19 Delta Rain
20 Destination Africa
21 Drifters Safaris
22 Eco Africa Botswana (Pty) Ltd
23 FPB Safaris - Green Bream
24 Free As The Wind
25 Game Trails
26 Geo Joy Investments
27 Get Up And Go safaris
28 Goshawk Ventures
29 Hawkers SAOS
30 Jo-Ann Safari Services - Drumbeat Safari
31 Karibu Safaris
32 Kgori Safaris
33 Linga Longa Safaris (Pty) Ltd
34 Lloyd Wilmot Safaris
35 Local Adventure safaris
36 Map Supplies & Safaris
37 Masson Safaris
38 Mickey Mafne Adventure Safaris
39 Naga Safaris
40 Naga Tours and Safaris
41 New Moon
42 Ngami Marine/Consolidates Services
43 No Name Africa Adventure
44 Nxamaseri Fishing Camp
45 Oasis Safaris
46 Okavango Trail (Pty) Ltd
47 Okavango Voyages
48 Okavango Wilderness Safaris
49 Penduka Safaris (Ensign Agencies)
50 Phakawe Safaris
51 Pick-up Investments Africa Calls
52 Planet Okavango t/a Calypso Agencies
53 Reeds And Grass Safaris Lodge
54 Rover Agencies Birding Botswana
55 Safari Drive
56 Safari Unlimited/Warthog
57 Scotts Holdings (Pty) Ltd
58 Sedia In-House Quadrum
59 Shangara Safaris
60 Shifting Sands t/a Bushway Safaris
61 Skatul Safaris T/A Penitone Safaris
62 Soren Lindstrom Safaris
63 Specialised Adventure Safaris t/a/ Gitar
64 Tebeleopele Community Trust/Kuchaa
65 U-nique Adventure Safaris
66 Veld Adventure Safari Lodge
67 Water Berry Safaris
68 Wild Life Styles

69 Wilderness Dawning
70 Wilmot Safaris

TRAVEL AGENCIES

1 African Pride
2 Okavango Tours and Safaris
3 Rover Agencies/ Bona Safari Services
4 Tete Store t/a Tete Travel & Tours
5 Time travel

6 Travel News Botswana
7 Bathusi Travel & Tours
8 Hartleys Safaris
9 Merlin Travel
10 The Booking Company
11 Travel Wild

15 APPENDIX 3. THE ECOTOURISM LODGE MODEL

DELTA STUDY
FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

ASSUMPTIONS*

Production System:	18	bed, up-market lodge offering all inclusive, guided, wildlife viewing.									
Site:	High quality, unfenced area with river/floodplain frontage and mixed population of northeastern woodland species.										
Game Density:	100%	6.23	LSU Equivalents/Sq. Km. or,			16	Hectares per LSU Equivalent				
Carrying Capacity:	100%	0.125	Tourist Beds/Sq. Km. or,			800	Ha. per Tourist Bed				
Concession Size:	14400	Hectares or,	144	Square Kilometres							
Tourist Category:	Overseas	80%	Regional	10%	Resident	5%	Citizen	5%			
	Adults	90%	Children	10%							
Occupancy Rate:	100%	57.5%	Average Length of Stay:		4 Days						
Daily Tariffs (P):	100%	Overseas	2486	Regional	2486	Resident	2486	Citizen	2486		
		Children	100%	of Adult Price							
Capital Item Prices:	100%	(Variation from Normal for Sensitivity Analysis)									
Capital Sources:	100%	Loan =	25%	Equity =	75%	and:	100%	Foreign	25%	Domestic	75%
Interest Rates:	100%	Rate for Capital Loans:	10%	Rate for Working Capital Loans:	15%						
Working Capital as Proportion of Annual Operating Costs:	20%										
Park Entry Fees:	100%	Fee per Tourist Night/Day:	P 30.00								
Land Rental and Resource Royalty (P):	100%	Rental:	17.10	per Ha.	100%	Royalty:	4%	of Turnover			
Manpower Needs:	100%	Managers	6	Skilled Labour	7	Unskilled Labour	15				
	100%	Management:		Foreign	50%	Citizen	50%				
Shadow Wage Adjustment:	100%	Managers	1.00	Skilled Labour	1.00	100%	Unskilled Labour	0.50			
Foreign Exchange Premium:	100%	6%	Adjustment Factor =	1.06							
Tax Adjustments:	100%	General Sales Tax:	11%	Import Taxes: from SACU:	0%	to SACU:	n/a				
Discount Rates:	100%	Financial Discount Rate:	8%	Economic Discount Rate:	8%						
Opportunity Cost of Capital:	100%	8%									

Static models depict enterprise at full production. Static financial model includes interest, amortisation government fees, royalties and land rentals. Static economic model takes foreign inflows and outflows into account, excludes other interest and transfers and values enterprise in economic prices before land and government costs

Dynamic models presented over 5 and 10 years, to measure IRR and NPV. Financial dynamic model, at constant prices, excludes interest and depreciation, and includes asset residual values. Economic model includes foreign inflows and outflows, and measures value of enterpise in economic prices before inclusion of land costs and public expenditures.

* Shaded cells indicate degree of conformity with base case values. Underlined shaded cells can be changed

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 1: CAPITAL REQUIREMENTS

ITEM	QUANT.	PRICE PULA	FINAN. COST	LIFE Years	AMORT. + INT.	DEPREC-IATION	ECON. DEPR.	FOREX ADJ.	TAX ADJ.	ECON. COST
FIXED CAPITAL										
DOMESTIC ITEMS										
Houses Manager	3	162180	486541	40	57149	12164	10826	1.00	0.89	433021
Houses Labour	18	24388	438984	40	51563	10975	9767	1.00	0.89	438984
Storerooms	1	243880	243880	40	28646	6097	5426	1.00	0.89	217053
Tourist Lodges	1	3182634	3182634	40	373831	79566	70814	1.00	0.89	2832544
Borehole	0	304850	0	40	0	0	0	1.00	0.89	0
Reservoir (Whole Water System)	1	792610	792610	40	93100	19815	17636	1.00	0.89	705423
Reticulation/Pans	0	5460	0	40	0	0	0	1.00	0.89	0
Firebreaks	0.00	7462	0	40	0	0	0	1.00	0.89	0
Hiking Trails	0.00	1092	0	40	0	0	0	1.00	0.89	0
Power/Road to Site	1	60970	60970	40	7162	1524	1357	1.00	0.89	54263
CONTINGENCIES @ 5%			260281	40	30573	6507	5791	1.00	0.89	231650
SUBTOTAL DOMESTIC ITEMS			5465900							4912939
TRADABLE ITEMS										
Boma	0	63882	0	20	0	0	0	1.06	0.89	0
Hiker Camps	0	0	0	15	0	0	0	1.06	0.89	0
Pump/Windmill	1	118300	118300	15	15553	7887	7440	1.06	0.89	111604
Fencing Perimeter	0.00	106707	0	15	0	0	0	1.06	0.89	0
Fencing Internal	0.00	97006	0	15	0	0	0	1.06	0.89	0
CONTINGENCIES @ 5%			5915	15	778	394	372	1.06	0.89	5580
SUBTOTAL TRADABLES			124215							117184
SUBTOTAL- FIXED CAPITAL			5590115							5030123
MOVABLE CAPITAL										
TRADABLE ITEMS										
Land Cruisers/Trucks/Vans	4	245045	980179	4	309218	245045	231175	1.06	0.89	924701
Tools/Office Equipment	1	54054	54054	6	12411	9009	8499	1.06	0.89	50995
Lodge Equipment	1	71171	71171	6	16341	11862	11190	1.06	0.89	67143
Boats	3	12012	36036	6	8274	6006	5666	1.06	0.89	33996
CONTINGENCIES @ 10%			114144	6	26208	19024	17947	1.06	0.89	107683
SUBTOTAL TRADABLES			1255584							1184518
DOMESTIC ITEMS										
Capture: Small Antelope	0	0	0	40	0			1.00	0.89	0
: Large Antelope	0	0	0	40	0			1.00	0.89	0
: Ostrich	0	0	0	40	0			1.00	0.89	0
: Other Animals	0	0	0	40	0			1.00	0.89	0
Horses and Donkeys	0	0	0	40	0			1.00	0.89	0
CONTINGENCIES @ 10%			0	40	0			1.00	0.89	0
SUBTOTAL- DOMESTIC ITEMS			0							0
SUBTOTAL- MOVABLE CAPITAL			1255584							1184518
WORKING CAPITAL			LOAN	INTEREST						
VARIABLE			775808	116371				1.06	1.00	822356
OVERHEAD			582828	87424				1.06	1.00	617798
SUBTOTAL- WORKING CAPITAL			1358636	203795						1440154
TOTALS			8204335	203795	1030806	435874	403907			7654795

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 2: STOCK COMPOSITION BY SPECIES AT FULL PRODUCTION

ITEM	HEAD	LSU FACTOR	LSU
Baboon	6	0.00	0
Black Rhinoceros	0	1.50	0
Buffalo	45	1.00	45
Burchells Zebra	12	0.63	8
Bushbuck	5	0.14	1
Bushpig	12	0.20	2
Cheetah	2	0.00	0
Crocodile	3	0.00	0
Duiker	8	0.07	1
Eland	7	1.00	7
Elephant	225	3.33	749
Giraffe	9	1.43	13
Hippo	23	1.50	34
Impala	38	0.14	5
Kudu	30	0.40	12
Lechwe	15	0.16	2
Leopard	5	0.00	0
Lion	2	0.00	0
Oribi	2	0.08	0
Ostrich	8	0.26	2
Reedbuck	8	0.14	1
Roan	3	0.65	2
Sable	12	0.40	5
Sitatunga	6	0.16	1
Spotted Hyaena	5	0.00	0
Steenbok	8	0.06	0
Tsessebe	4	0.26	1
Warthog	23	0.20	5
Waterbuck	0	0.37	0
Wildebeest	3	0.40	1
TOTAL	524		897

GAME DENSITY: 6.23 LSU PER SQ.KM.; CONCESSION SIZE: 14400 HECTARES

TABLE 3: SALES AT FULL PRODUCTION

ITEM	VISITOR DAYS	@	RATE P/Day	FINANCIAL VALUE	FOREX ADJ.	TAX ADJ.	ECON. VALUE
Overseas Adults	2720	@	2486	6761532	1.06	1.00	7167224
Regional Adults	340	@	2486	845192	1.06	1.00	895903
Resident Adults	170	@	2486	422596	1.06	1.00	447952
Citizen Adults	170	@	2486	422596	1.00	1.00	422596
Overseas Children	302	@	2486	751281	1.06	1.00	796358
Regional Children	38	@	2486	93910	1.06	1.00	99545
Resident Children	19	@	2486	46955	1.06	1.00	49772
Citizen Children	19	@	2486	46955	1.00	1.00	46955
Optional Excursions				0	1.06	1.00	0
Bar				0	1.06	1.00	0
Crafts/Curios				56666	1.06	1.00	60066
TOTALS	3778		GROSS INCOME	9447683			9986371

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 4: VARIABLE EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES				FOREX	TAX	ECONOMIC VALUES		
	P/LSU	P/HA.	VALUE		ADJ.	ADJ.	P/LSU	P/HA.	VALUE
TRADABLE ITEMS				0.25					
				2361921					
Marketing Costs: Advertising	1053.25	65.61	944768		1.06	0.89	993.63	61.90	891294
: Agents Fees	1579.87	98.41	1417152		1.06	0.89	1674.66	104.32	1502182
Lodge Running Costs : Accomodation	153.30	9.55	137510		1.06	0.89	144.62	9.01	129727
: Transport	42.31	2.64	37953		1.06	0.89	39.92	2.49	35805
: Optional Activ.	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Bar	107.31	6.68	96257		1.06	0.89	101.24	6.31	90809
: Crafts/Curios	63.62	3.96	57067		1.06	0.89	60.02	3.74	53837
Fodder and Supplements	0.00	0.00	0		1.06	0.89	0.00	0.00	0
Offtake Costs: Ammunition	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Supplies and Packaging	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Transport	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Live Game Distribution	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Biltong Distribution	0.00	0.00	0		1.06	0.89	0.00	0.00	0
Fuels, Oils and Miscellaneous Costs	39.86	2.48	35753		1.06	0.89	37.60	2.34	33729
SUBTOTAL TRADABLES	3039.51	189.34	2726460				3051.69	190.10	2737382
DOMESTIC ITEMS									
Veterinary and Medicine Costs	0.00	0.00	0		1.00	0.89	0.00	0.00	0
Licence Fees: Park Entrance Fees	126.35	7.87	113333		1.00	1.00	0.00	0.00	0
: Hunting Licences	0.00	0.00	0		1.00	1.00	0.00	0.00	0
Sales Tax	1158.57	72.17	1039245		1.00	1.00	0.00	0.00	0
SUBTOTAL DOMESTIC ITEMS	1284.92	80.04	1152578				0.00	0.00	0
TOTAL VARIABLE EXPENDITURE	4324.43	269.38	3879038				3051.69	190.10	2737382

TABLE 5: OPERATING OVERHEAD EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES				FOREX	TAX	ECONOMIC VALUES		
	P/LSU	P/HA.	VALUE		ADJ.	ADJ.	P/LSU	P/HA.	VALUE
DOMESTIC ITEMS				0.25					
				2369640					
Salaries and Wages: Unskilled Labour	340.87	21.23	305760	0.29	1.00	1.00	340.87	21.23	152880
: Skilled Labour	596.52	37.16	535080		1.00	1.00	596.52	37.16	476221
: Managers	1704.34	106.17	1528800		1.00	1.00	1704.34	106.17	1528800
Administration	79.13	4.93	70980		1.00	0.89	79.13	4.93	63172
Maintenance and Repairs	146.30	9.11	131236		1.00	0.89	146.30	9.11	116800
Insurance	381.59	23.77	342285		1.00	0.89	381.59	23.77	304634
Travelling	0.00	0.00	0		1.00	0.89	0.00	0.00	0
TOTAL OPERATING OVERHEAD EXPEND.	3248.74	202.37	2914141				3248.74	202.37	2642507

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 6: STATIC FINANCIAL MODEL (AT FULL PRODUCTION)

ITEM	UNITS	TOTAL
Concession Extent	Hectares	14400
Concession Stock	Large Stock Units (LSU)	897
Total Capital Requirement	PULA	8204335

	P/LSU	P/HECTARE	PULA
GROSS INCOME	10532.46	656.09	9447683
VARIABLE COSTS	4324.43	269.38	3879038
GROSS MARGIN	6208.04	386.71	5568645
OVERHEAD COSTS			
Overhead Operating Costs	3248.74	202.37	2914141
Loan Amortisation and Interest	287.29	17.90	257702
Provisions for Capital Replacement	364.44	22.70	326906
Interest on Variable Working Capital	129.73	8.08	116371
Interest on Overhead Working Capital	97.46	6.07	87424
Land Rental	274.52	17.10	246245
Resource Royalty	421.30	26.24	377907
TOTAL OVERHEAD COSTS	4823.49	300.46	4326696
NET CASH INCOME	1384.55	86.25	1241949
NET CASH INCOME/P100 TOTAL CAPITAL INVESTMENT	15.14		
"TOTAL BENEFITS"*/P100 TOTAL CAPITAL INVESTMENT	65.68		
"TOTAL BENEFITS"*/HECTARE	374.19		

* "Total Benefits" = all of Net Cash Income, Salaries and Wages, Licences and Duties, Rental and Royalties.

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 7: STATIC ECONOMIC MODEL (AT FULL PRODUCTION)

ITEM	UNITS	TOTAL
Concession Extent	Hectares	14400
Concession Stock	Large Stock Units (LSU)	897
Total Capital Requirement	PULA	7654795
Economic Depreciation Cost	PULA	403907
Foreign Financing (Prorated)	PULA	115507
Foreign Amortisation	PULA	28877
Foreign Capital Replacement Provision	PULA	86630
Foreign Interest Cost	PULA	211663
Domestic Interest Cost	PULA	634989

ECONOMIC BENEFITS	P/LSU	P/HECTARE	PULA
Gross Income	11133.00	693.50	9986371
ECONOMIC COSTS			
DOMESTIC COMPONENT			
Shadow Unskilled Citizen Wages	170.43	10.62	152880
Other Citizen Wages	1383.07	86.15	1240621
Opportunity Cost of Capital	682.70	42.53	612384
Other Domestic Economic Costs	540.25	33.65	484606
SUBTOTAL DOMESTIC COMPONENT	2776.45	172.95	2490491
TRADABLE COMPONENT			
Foreign Remuneration	852.17	53.08	764400
Foreign Services	2134.64	132.97	1914781
Foreign Interest	235.97	14.70	211663
Foreign Lease Payments	0.00	0.00	0
Foreign Rentals	0.00	0.00	0
Foreign Net Income	366.91	22.86	329117
Other Tradable Economic Costs	917.05	57.13	822602
SUBTOTAL TRADABLE COMPONENT	4506.73	280.73	4042562
TOTAL ECONOMIC COSTS	7283.18	453.68	6533053
GROSS VALUE ADDED TO NATIONAL INCOME	3849.83	239.81	3453318
NET VALUE ADDED (Excluding Depreciation)	3399.54	211.76	3049412
STATISTICAL GROSS VALUE ADDED	5403.33	336.58	4846820
DOMESTIC RESOURCE COST RATIO =	0.53		
NET VALUE ADDED/P100 TOTAL CAPITAL COST =	39.84		
CAPITAL COST/EMPLOYMENT OPPORTUNITY CREATED =	273386		
NUMBER OF EMPLOYMENT OPPORTUNITIES/1000 HA.	1.94		

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 8: CAPITAL PHASING, DEPRECIATION SCHEDULE AND CALCULATION OF RESIDUAL VALUE (PULA)

ITEM	LIFE (Yrs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
DEPRECIABLE ASSETS												
"Forty Year" Items	40											
Total Expenditure		5465900										
Phased Expenditure		3279540	2186360	0	0	0	0	0	0	0	0	0
Depreciation		81988	136647	136647	136647	136647	136647	136647	136647	136647	136647	136647
Residual value		3279540	5383911	5247264	5110616	4973969	4837321	4700674	4564026	4427379	4290731	4154084
"Twenty Year" Items	20											
Total Expenditure		0										
Phased Expenditure		0	0	0	0	0	0	0	0	0	0	0
Depreciation		0	0	0	0	0	0	0	0	0	0	0
Residual value		0	0	0	0	0	0	0	0	0	0	0
"Fifteen Year" Items	15											
Total Expenditure		124215										
Phased Expenditure		74529	49686	0	0	0	0	0	0	0	0	0
Depreciation		4969	8281	8281	8281	8281	8281	8281	8281	8281	8281	8281
Residual value		74529	119246	110965	102684	94403	86122	77841	69560	61279	52998	44717
"Six Year" Items	6						6					
Total Expenditure		275405						275405				
Phased Expenditure		192784	82622	0	0	0	0	192784	82622	0	0	0
Depreciation		32131	45901	45901	45901	45901	45901	45901	45901	45901	45901	45901
Residual value		192784	243275	197374	151473	105572	59671	206554	243275	197374	151473	105572
"Four Year" Items	4											
Total Expenditure		980179				980179				980179		
Phased Expenditure		980179	0	0	0	980179	0	0	0	980179	0	0
Depreciation		245045	245045	245045	245045	245045	245045	245045	245045	245045	245045	245045
Residual value		980179	735134	490090	245045	980179	735134	490090	245045	980179	735134	490090
NON DEPRECIABLE ASSETS												
Stock	-											
Phased Expenditure		0	0	0	0	0	0	0	0	0	0	0
Residual value		0	0	0	0	0	0	0	0	0	0	0
Working Capital	-											
Phased Expenditure		1358636	0	0	0	0	0	0	0	0	0	0
TOTAL PHASED CAPITAL EXPENDITURE												
Domestic Component		3279540	2186360	0	0	0	0	0	0	0	0	0
Tradable Component		1247492	132308	0	0	980179	0	192784	82622	980179	0	0
Total Financial Value		4527032	2318667	0	0	980179	0	192784	82622	980179	0	0
Total Economic Value		4095674	2070679	0	0	924701	0	181872	77945	924701	0	0
TOTAL ASSET RESIDUAL VALUE												
Domestic Component		3279540	5383911	5247264	5110616	4973969	4837321	4700674	4564026	4427379	4290731	4154084
Tradable Component		1247492	1097655	798429	499202	1180155	880928	774485	557880	1238832	939606	640379
Financial Value		4527032	6481566	6045692	5609818	6154123	5718249	5475158	5121906	5666211	5230337	4794463
Economic Value		4095674	5827209	5423302	5019395	5540190	5136283	4914249	4588287	5109081	4705175	4301268

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TABLE 9: LOAN FINANCING SCHEDULE (PULA)

ITEM PERIOD	(Yrs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
LONG TERM LOANS												
TWENTY YEAR LOAN	20											
Total Expenditure		1366475										
Loan Disbursements		819885	546590	0	0	0	0	0	0	0	0	0
Loan Payments		96303	160506	160506	160506	160506	160506	160506	160506	160506	160506	160506
Amortisation		40994	68324	68324	68324	68324	68324	68324	68324	68324	68324	68324
Interest Payments		55309	92182	92182	92182	92182	92182	92182	92182	92182	92182	92182
Loans Outstanding		819885	1325481	1257157	1188833	1120509	1052186	983862	915538	847214	778891	710567
FIFTEEN YEAR LOAN	15											
Total Expenditure		31054										
Loan Disbursements		23290	7763	0	0	0	0	0	0	0	0	0
Loan Payments		3062	4083	4083	4083	4083	4083	4083	4083	4083	4083	4083
Amortisation		1553	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070
Interest Payments		1509	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013
Loans Outstanding		23290	29501	27431	25361	23290	21220	19150	17080	15009	12939	10869
SIX YEAR LOAN	6						6					
Total Expenditure		68851						68851				
Loan Disbursements		48196	20655	0	0	0	0	48196	20655	0	0	0
Loan Payments		11066	15809	15809	15809	15809	15809	15809	15809	15809	15809	15809
Amortisation		8033	11475	11475	11475	11475	11475	11475	11475	11475	11475	11475
Interest Payments		3033	4334	4334	4334	4334	4334	4334	4334	4334	4334	4334
Loans Outstanding		48196	60819	49343	37868	26393	14918	51638	60819	49343	37868	26393
FOUR YEAR LOAN	4											
Total Expenditure		245045				245045				245045		
Loan Disbursements		245045	0	0	0	245045	0	0	0	245045	0	0
Loan Payments		77304	77304	77304	77304	77304	77304	77304	77304	77304	77304	77304
Amortisation		61261	61261	61261	61261	61261	61261	61261	61261	61261	61261	61261
Interest Payments		16043	16043	16043	16043	16043	16043	16043	16043	16043	16043	16043
Loans Outstanding		245045	183784	122522	61261	245045	183784	122522	61261	245045	183784	122522
SHORT TERM LOANS												
Working Capital	1											
Overdraft		1358636	1358636	1358636	1358636	1358636	1358636	1358636	1358636	1358636	1358636	1358636
Interest Payments		203795	203795	203795	203795	203795	203795	203795	203795	203795	203795	203795
TOTAL LONG TERM LOAN DISBURSMENTS												
Domestic Component		852312	431257	0	0	183784	0	36147	15492	183784	0	0
Foreign Component *		301150	152377	0	0	64937	0	12772	5474	64937	0	0
TOTAL LONG TERM LOAN AMORTISATION												
Domestic Component		83881	107348	107348	107348	107348	107348	107348	107348	107348	107348	107348
Foreign Component *		29638	37930	37930	37930	37930	37930	37930	37930	37930	37930	37930
TOTAL INTEREST PAYMENTS												
Domestic Component		209768	238775	238775	238775	238775	238775	238775	238775	238775	238775	238775
Foreign Component *		74118	84367	84367	84367	84367	84367	84367	84367	84367	84367	84367
TOTAL LOANS OUTSTANDING												
Domestic Component		852312	1199688	1092340	984992	1061428	954080	882879	791023	867459	760111	652763
Foreign Component *		301150	423890	385960	348031	375038	337108	311951	279495	306502	268573	230643

* Economic Values

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 10: FINANCIAL ANALYSIS - 5 YEARS (PULA)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EXPENDITURE						
Capital Expenditure	4527032	2318667	0	0	980179	0
Variable Expenditure	387904	2327423	3879038	3879038	3879038	3879038
Overhead Expenditure	3538293	3538293	3538293	3538293	3538293	3538293
TOTAL EXPENDITURE	8453229	8184383	7417331	7417331	8397510	7417331
INCOME						
Gross Income	0	4723842	8502915	9447683	9447683	9447683
Asset Residual Value	0	0	0	0	0	5718249
TOTAL INCOME	0	4723842	8502915	9447683	9447683	15165932
NET BENEFIT/COST	-8453229	-3460542	1085584	2030352	1050173	7748601

FINANCIAL RATE OF RETURN (FRR) OVER 5 YEARS	=	0.00%
NET PRESENT VALUE (NPV) @ 8.00%	=	-2842117

TABLE 11: FINANCIAL ANALYSIS - 7 YEARS (PULA)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
EXPENDITURE								
Capital Expenditure	4527032	2318667	0	0	980179	0	192784	82622
Variable Expenditure	387904	2327423	3879038	3879038	3879038	3879038	3879038	3879038
Overhead Expenditure	3538293	3538293	3538293	3538293	3538293	3538293	3538293	3538293
TOTAL EXPENDITURE	8453229	8184383	7417331	7417331	8397510	7417331	7610115	7499953
INCOME								
Gross Income	0	4723842	8502915	9447683	9447683	9447683	9447683	9447683
Asset Residual Value	0	0	0	0	0	0	0	5121906
TOTAL INCOME	0	4723842	8502915	9447683	9447683	9447683	9447683	14569589
NET BENEFIT/COST	-8453229	-3460542	1085584	2030352	1050173	2030352	1837568	7069636

FINANCIAL RATE OF RETURN (FRR) OVER 7 YEARS	=	4.72%
NET PRESENT VALUE (NPV) @ 8.00%	=	-1553875

TABLE 12: FINANCIAL ANALYSIS - 10 YEARS (PULA)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
EXPENDITURE											
Capital Expenditure	4527032	2318667	0	0	980179	0	192784	82622	980179	0	0
Variable Expenditure	387904	2327423	3879038	3879038	3879038	3879038	3879038	3879038	3879038	3879038	3879038
Overhead Expenditure	3538293	3538293	3538293	3538293	3538293	3538293	3538293	3538293	3538293	3538293	3538293
TOTAL EXPENDITURE	8453229	8184383	7417331	7417331	8397510	7417331	7610115	7499953	8397510	7417331	7417331
INCOME											
Gross Income	0	4723842	8502915	9447683	9447683	9447683	9447683	9447683	9447683	9447683	9447683
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	4794463
TOTAL INCOME	0	4723842	8502915	9447683	9447683	9447683	9447683	9447683	9447683	9447683	14242146
NET BENEFIT/COST	-8453229	-3460542	1085584	2030352	1050173	2030352	1837568	1947731	1050173	2030352	6824815

FINANCIAL RATE OF RETURN (FRR) OVER 10 YEARS	=	8.11%
NET PRESENT VALUE (NPV) @ 8.00%	=	71758

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TABLE 13: ECONOMIC ANALYSIS - 5 YEARS (PULA)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ECONOMIC COSTS						
Capital Expenditure	4095674	2070679	0	0	924701	0
Unskilled Wages	152880	152880	152880	152880	152880	152880
Other Domestic Costs	1380182	1725227	1725227	1725227	1725227	1725227
Tradable Costs	347291	2083743	3472906	3472906	3472906	3472906
Foreign Amortisation	29638	37930	37930	37930	37930	37930
Foreign Profits	0	23038	263293	329117	329117	329117
Foreign Loans Outst.	0	0	0	0	0	337108
TOTAL COSTS	6005664	6093498	5652236	5718059	6642760	6055168
ECONOMIC BENEFITS						
Gross Income	0	4993186	8987734	9986371	9986371	9986371
Asset Residual Value	0	0	0	0	0	5136283
Foreign Financing	301150	152377	0	0	64937	0
TOTAL BENEFITS	301150	5145563	8987734	9986371	10051308	15122654
NET BENEFIT/COST	-5704514	-947935	3335498	4268312	3408548	9067487

ECONOMIC RATE OF RETURN (ERR) OVER 5 YEARS		=	36.28%
NET PRESENT VALUE (NPV) @	8.00%	=	7724359

TABLE 14: ECONOMIC ANALYSIS - 10 YEARS (PULA)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
ECONOMIC COSTS											
Capital Expenditure	4095674	2070679	0	0	924701	0	181872	77945	924701	0	0
Unskilled Wages	152880	152880	152880	152880	152880	152880	152880	152880	152880	152880	152880
Other Domestic Costs	1380182	1725227	1725227	1725227	1725227	1725227	1725227	1725227	1725227	1725227	1725227
Tradable Costs	347291	2083743	3472906	3472906	3472906	3472906	3472906	3472906	3472906	3472906	3472906
Foreign Amortisation	29638	37930	37930	37930	37930	37930	37930	37930	37930	37930	37930
Foreign Profits	0	23038	263293	329117	329117	329117	329117	329117	329117	329117	329117
Foreign Loans Outst.	0	0	0	0	0	0	0	0	0	0	230643
TOTAL COSTS	6005664	6093498	5652236	5718059	6642760	5718059	5899931	5796004	6642760	5718059	5948702
ECONOMIC BENEFITS											
Gross Income	0	4993186	8987734	9986371	9986371	9986371	9986371	9986371	9986371	9986371	9986371
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	4301268
Foreign Financing	301150	152377	0	0	64937	0	12772	5474	64937	0	0
TOTAL BENEFITS	301150	5145563	8987734	9986371	10051308	9986371	9999143	9991845	10051308	9986371	14287639
NET BENEFIT/COST	-5704514	-947935	3335498	4268312	3408548	4268312	4099212	4195841	3408548	4268312	8338937

ECONOMIC RATE OF RETURN (ERR) OVER 10 YEARS		=	41.17%
NET PRESENT VALUE (NPV) @	8.00%	=	16617402

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA TOURISM - NGAMILAND 2006 - BASE CASE

TABLE 15: SUMMARY OF RESULTS

ITEM	UNITS	TOTAL
Concession Extent	Hectares	14400
Concession Stock	Large Stock Units (LSU)	897
Annual Visitor Days (VD)	Number	3778

ITEM	% of TCI	P/VISITOR DAY	P/LSU	P/HECTARE	PULA
Total Financial Capital (TCI)	-	2171.75	9146.35	569.75	8204335
Financial Gross Income	115.15%	2500.88	10532.46	656.09	9447683
Variable Financial Costs	-	1026.81	4324.43	269.38	3879038
Fixed Financial Costs	-	1145.31	4823.49	300.46	4326696
Net Cash Income	15.14%	328.75	1384.55	86.25	1241949
Local Community Cash Income	14.85%	322.61	1358.68	84.64	1218747
Land Rental	-	65.18	274.52	17.10	246245
Resource Royalty	-	100.04	421.30	26.24	377907
FRR (@ 10 Years)	-	-	-	-	8.11%
FNPV (@ 8%, @ 10 Years)	-	-	-	4.98	71758
Total Economic Capital	-	2026.28	8533.72	531.58	7654795
Economic Gross Income	130.46%	2643.47	11133.00	693.50	**9986371**
Economic Costs	85.35%	1729.35	7283.18	453.68	6533053
Incremental Gross Value Added	45.11%	914.12	3849.83	239.81	**3453318**
Incremental Net Value Added	39.84%	807.20	3399.54	211.76	3049412
Statistical Gross Value Added	63.32%	1282.99	5403.33	336.58	**4846820**
ERR (@ 10 Years)	-	-	-	-	41.17%
ENPV (@ 8%, @ 10 Years)	-	-	-	1153.99	16617402
Economic Capital Cost/Job	-	-	-	-	273386
Domestic Resource Cost Ratio	-	-	-	-	0.53

Policy Analysis Matrix	: Effects of Policy / Market Imperfections	: on Output	-538688
		: on Tradable Inputs	1316102
		: on Domestic Factors	-2584876
	: Net Effects of Policy / Market Imperfections	: on Annual Net Income	-1807462
		: on Net Present Value (10 Years)	-16545644

16 APPENDIX 4. THE SAFARI HUNTING ENTERPRISE MODEL

DELTA STUDY
FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA SAFARI HUNTING - NGAMILAND 2006 - BASE CASE

ASSUMPTIONS*

Production System:	8	bed, up-market lodge offering all inclusive, guided, wildlife hunts.									
Site:	High quality, unfenced area with riparian, wetland and woodland setting and mixed population of Okavango delta species on quota.										
Game Density:	100%	6.41	LSU Equivalents/Sq. Km. or,			16	Hectares per LSU Equivalent				
Carrying Capacity:	100%	0.010	Tourist Beds/Sq. Km. or,			10000	Ha. per Tourist Bed				
Concession Size:	80000	Hectares or,	800	Square Kilometres			(Share of larger area)				
Tourist Category:	Overseas	95%	Regional	5%	Resident	0%	Citizen	0%			
	Average Group Size:	1.5	Hunters	1	Observers	0.5					
Occupancy Rate:	Overall	18%	No. of	12 to 21	Day Hunts =	16	Total =	241	Hunter Days		
Daily Tariffs (N$):	100%	Overseas	8736	Regional	8736	Resident	8736	Citizen	8736		
	Observer's Tariff as Percent of Full Price:	50%									
Capital Item Prices:	100%	(Variation from Normal for Sensitivity Analysis)									
Capital Sources:	100%	Loan =	25%	Equity =	75%	and:	100%	Foreign	25%	Domestic	75%
Interest Rates:	Rate for Capital Loans:	10%	Rate for Working Capital Loans:	15%							
Working Capital as Proportion of Annual Operating Costs:	20%										
Park Entry Fees:	100%	Fee per Tourist Night/Day: N$	0.00								
Land Rental and Resource Royalty (N$):	100%	Rental:	2.75	per Ha.	100%	Royalty:	4%	of Turnover			
Personpower Needs:	100%	Managers	3	Skilled Labour	4	Unskilled Labour	5				
	100%	Management:		Foreign	50%	Citizen	50%				
Shadow Wage Adjustment:	100%	Managers	1.00	Skilled Labour	1.00	100%	Unskilled Labour	0.50			
Foreign Exchange Premium:	100%	6%	Adjustment Factor =	1.06							
Tax Adjustments:	100%	General Sales Tax:	11%	Import Taxes: from SACU:	0%	to SACU:	n/a				
Discount Rates:	100%	Financial Discount Rate:	8%	Economic Discount Rate:	8%						

Static models depict enterprise at full production. Static financial model includes interest, amortisation government fees, royalties and land rentals. Static economic model takes foreign inflows and outflows into account, excludes other interest and transfers and values enterprise in economic prices before land and government costs

Dynamic models presented over 5 and 10 years, to measure IRR and NPV. Financial dynamic model, at constant prices, excludes interest and depreciation, and includes asset residual values. Economic model includes foreign inflows and outflows, and measures value of enterpise in economic prices before inclusion of land costs and public expenditures.

* Shaded cells indicate degree of conformity with base case values. Underlined shaded cells can be changed

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA SAFARI HUNTING - NGAMILAND 2006 - BASE CASE

TABLE Sa1: CAPITAL REQUIREMENTS

ITEM	QUANT.	PRICE N$	FINAN. COST	LIFE Years	AMORT. + INT.	DEPREC-IATION	ECON. DEPR.	FOREX ADJ.	TAX ADJ.	ECON. COST
FIXED CAPITAL										
DOMESTIC ITEMS										
Houses Manager	3	0	0	40	0	0	0	1.00	0.89	0
Houses Labour	9	0	0	40	0	0	0	1.00	0.89	0
Storerooms	0	200000	0	40	0	0	0	1.00	0.89	0
Tourist Lodges	1	337500	337500	40	39643	8438	7509	1.00	0.89	300375
Boreholes/Wells	1	625000	625000	40	73412	15625	13906	1.00	0.89	556250
Reservoir (Whole Water System)	1	138500	138500	40	16268	3463	3082	1.00	0.89	123265
Reticulation/Pans	0	7500	0	40	0	0	0	1.00	0.89	0
Firebreaks	0.00	10250	0	40	0	0	0	1.00	0.89	0
Hiking Trails	0.00	1500	0	40	0	0	0	1.00	0.89	0
Power/Road to Site	1	20000	20000	40	2349	500	445	1.00	0.89	17800
CONTINGENCIES @ 5%			56050	40	6584	1401	1247	1.00	0.89	49885
SUBTOTAL DOMESTIC ITEMS			1177050							1047575
TRADABLE ITEMS										
Boma	0	67500	0	20	0	0	0	1.06	0.89	0
Hiker Camps	0	0	0	15	0	0	0	1.06	0.89	0
Pump/Windmill	1	650000	650000	15	85458	43333	40881	1.06	0.89	613210
Fencing Perimeter	0.00	112750	0	15	0	0	0	1.06	0.89	0
Fencing Internal	0.00	102500	0	15	0	0	0	1.06	0.89	0
CONTINGENCIES @ 5%			32500	15	4273	2167	2044	1.06	0.89	30661
SUBTOTAL TRADABLES			682500							643871
SUBTOTAL- FIXED CAPITAL			1859550							1691445
MOVABLE CAPITAL										
TRADABLE ITEMS										
Land Cruisers/Trucks/Vans	3	106400	319200	4	100698	79800	75283	1.06	0.89	301133
Tents	10	30000	300000	6	68882	50000	47170	1.06	0.89	283020
Tools/Equipment	1	327080	327080	6	75100	54513	51428	1.06	0.89	308567
Boats	0	110000	0	6	0	0	0	1.06	0.89	0
CONTINGENCIES @ 10%			94628	6	21727	15771	14879	1.06	0.89	89272
SUBTOTAL TRADABLES			1040908							981993
DOMESTIC ITEMS										
Capture: Small Antelope	0	300	0	40	0			1.00	0.89	0
: Large Antelope	0	300	0	40	0			1.00	0.89	0
: Ostrich	0	300	0	40	0			1.00	0.89	0
: Other Animals	0	300	0	40	0			1.00	0.89	0
Horses and Donkeys	0	300	0	40	0			1.00	0.89	0
CONTINGENCIES @ 10%			0	40	0			1.00	0.89	0
SUBTOTAL- DOMESTIC ITEMS			0							0
SUBTOTAL- MOVABLE CAPITAL			1040908							981993
WORKING CAPITAL			LOAN	INTEREST						
VARIABLE			359164	53875				1.06	1.00	380714
OVERHEAD			288698	43305				1.06	1.00	306020
SUBTOTAL- WORKING CAPITAL			647862	97179						686734
TOTALS			3548320	97179	494394	275011	257874			3360171

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TABLE Sa2: STOCK COMPOSITION BY SPECIES AT FULL PRODUCTION

ITEM	HEAD	OFFTAKE %	NO.	PRICE	FIN. VALUE	LSU FACTOR	LSU
Baboon	67	3.00%	2.00	1820	3640	0.00	0
Black Rhinoceros	0	0.00%	0.00	168000	0	1.50	0
Buffalo	563	1.60%	9.00	18200	163800	1.00	563
Burchells Zebra	208	2.88%	6.00	7280	43680	0.63	131
Bushbuck	0	2.16%	0.00	1819	0	0.14	0
Bushpig	0	1.18%	0.00	1212	0	0.20	0
Cheetah	0	0.00%	0.00	24248	0	0.00	0
Crocodile	33	3.00%	1.00	6552	6552	0.00	0
Duiker	0	0.54%	0.00	728	0	0.07	0
Eland	0	1.44%	0.00	13832	0	1.00	0
Elephant	714	0.70%	5.00	138320	691600	3.33	2379
Gemsbok	0	2.88%	0.00	8736	0	0.40	0
Giraffe	0	0.00%	0.00	12124	0	1.50	0
Hartebeest	1032	1.55%	16.00	6552	104832	0.26	268
Impala	926	2.16%	20.00	2912	58240	0.14	130
Klipspringer	0	2.69%	0.00	1516	0	0.07	0
Kudu	556	1.44%	8.00	9464	75712	0.40	222
Lechwe	1157	2.16%	25.00	6552	163800	0.16	185
Leopard	0	0.00%	5.00	29848	149240	0.00	0
Lion	67	3.00%	2.00	40040	80080	0.00	0
Mountain Zebra	0	3.00%	0.00	9237	0	0.63	0
Ostrich	100	2.00%	2.00	3276	6552	0.26	26
Reedbuck	463	2.16%	10.00	4732	47320	0.14	65
Roan	0	1.44%	0.00	30310	0	0.65	0
Sable	69	1.44%	1.00	23296	23296	0.40	28
Spotted Hyaena	167	3.00%	5.00	3640	18200	0.00	0
Springbok	0	2.57%	0.00	2184	0	0.08	0
Steenbok	1639	0.12%	2.00	728	1456	0.06	98
Tsessebe	1597	1.44%	23.00	5824	133952	0.26	415
Warthog	1017	1.18%	12.00	2184	26208	0.20	203
Waterbuck	0	1.44%	0.00	9464	0	0.37	0
Wildebeest	1032	1.55%	16.00	6916	110656	0.40	413
TOTAL	0 0 11408		170		1908816		5126

GAME DENSITY ON LAN 6.41 LSU PER SQ.KM.; CONCESSION SIZE: 80000 HECTARES

TABLE Sa3: SALES AT FULL PRODUCTION

ITEM	VISITOR DAYS	@ RATE (N$/Day)	FINANCIAL VALUE		FOREX ADJ.	TAX ADJ.	ECONOMIC VALUE
				0.12			
Overseas Hunters	229	@ 8736 N$/Day =	2000107	4349072	1.06	0.89	1886901
Regional Hunters	12	@ 8736 N$/Day =	105269		1.06	0.89	99311
Resident Hunters	0	@ 8736 N$/Day =	0		1.06	0.89	0
Citizen Hunters	0	@ 8736 N$/Day =	0		1.00	0.89	0
Overseas Observers	114	@ 4368 N$/Day =	500027	526344	1.06	0.89	471725
Regional Observers	6	@ 4368 N$/Day =	26317		1.06	0.89	24828
Resident Observers	0	@ 4368 N$/Day =	0		1.06	0.89	0
Citizen Observers	0	@ 4368 N$/Day =	0		1.00	0.89	0
Trophy Fees			1908816		1.06	0.89	1800777
Dip and Pack			145600		1.06	0.89	137359
Other (Gun Hire, Tips, etc.)			189280		1.06	0.89	178567
TOTALS	362	GROSS INCOME	4875416				4599467

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TABLE Sa4: VARIABLE EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES N$/LSU	N$/HA.	VALUE		FOREX ADJ.	TAX ADJ.	ECONOMIC VALUES N$/LSU	N$/HA.	VALUE
TRADABLE ITEMS				0.25					
				1218854					
Marketing Costs: Advertising	47.55	3.05	243771	5.00%	1.06	0.89	44.86	2.87	229973
: Agents Fees	190.21	12.19	975083	20.00%	1.06	0.89	179.45	11.50	919893
Lodge Running Costs : Accomodation	11.65	0.75	59720	1.22%	1.06	0.89	10.99	0.70	56340
: Transport	14.11	0.90	72345	1.48%	1.06	0.89	13.31	0.85	68250
: Optional Activ.	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Bar	0.00	0.00	0	0.00%	1.06	0.89	0.00	0.00	0
: Crafts/Curios	0.13	0.01	672	0.01%	1.06	0.89	0.12	0.01	634
Fodder and Supplements	0.00	0.00	0		1.06	0.89	0.00	0.00	0
Offtake Costs: Ammunition	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Supplies and Packaging	10.21	0.65	52360	1.07%	1.06	0.89	9.64	0.62	49396
: Transport	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Live Game Distribution	0.00	0.00	0		1.06	0.89	0.00	0.00	0
: Biltong Distribution	0.00	0.00	0		1.06	0.89	0.00	0.00	0
Fuels, Oils and Miscellaneous Costs	7.90	0.51	40488	0.83%	1.06	0.89	7.45	0.48	38196
SUBTOTAL TRADABLES	281.77	18.06	1444439	29.63%			265.82	17.03	1362684
DOMESTIC ITEMS									
Veterinary and Medicine Costs	0.00	0.00	0		1.00	0.89	0.00	0.00	0
Licence Fees: Park Entrance Fees	0.00	0.00	0		1.00	1.00	0.00	0.00	0
: Hunting Licences	0.00	0.00	0		1.00	1.00	0.00	0.00	0
Sales Tax	68.55	4.39	351381		1.00	1.00	68.55	4.39	351381
SUBTOTAL DOMESTIC ITEMS	68.55	4.39	351381				68.55	4.39	351381
TOTAL VARIABLE EXPENDITURE	350.32	22.45	1795820				334.37	21.43	1714065

TABLE Sa5: OPERATING OVERHEAD EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES N$/LSU	N$/HA.	VALUE		FOREX ADJ.	TAX ADJ.	ECONOMIC VALUES N$/LSU	N$/HA.	VALUE
DOMESTIC ITEMS				0.31					
				1254400					
Salaries and Wages: Unskilled Labour	17.48	1.12	89600		1.00	1.00	17.48	1.12	44800
: Skilled Labour	69.91	4.48	358400		1.00	1.00	69.91	4.48	318976
: Managers	157.31	10.08	806400		1.00	1.00	157.31	10.08	806400
Administration	7.02	0.45	36000	0.74%	1.00	0.89	7.02	0.45	32040
Maintenance and Repairs	15.81	1.01	81050		1.00	0.89	15.81	1.01	72134
Insurance	6.13	0.39	31441		1.00	0.89	6.13	0.39	27982
Travelling	7.92	0.51	40600		1.00	0.89	7.92	0.51	36134
TOTAL OPERATING OVERHEAD EXPENDITU	281.59	18.04	1443491				281.59	18.04	1338467

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TABLE Sa6: STATIC FINANCIAL MODEL (AT FULL PRODUCTION)

ITEM	UNITS		TOTAL
Concession Extent	Hectares		80000
Concession Stock	Large Stock Units (LSU)		5126
Total Capital Requirement	N$		3548320
	N$/LSU	N$/HECTARE	N$
GROSS INCOME	951.07	60.94	4875416
VARIABLE COSTS	350.32	22.45	1795820
GROSS MARGIN	600.75	38.49	3079596
OVERHEAD COSTS			
Overhead Operating Costs	281.59	18.04	1443491
Loan Amortisation and Interest	24.11	1.54	123599
Provisions for Capital Replacement	40.24	2.58	206258
Interest on Variable Working Capital	10.51	0.67	53875
Interest on Overhead Working Capital	8.45	0.54	43305
Land Rental	42.92	2.75	220000
Resource Royalty	38.04	2.44	195017
TOTAL OVERHEAD COSTS	445.85	28.57	2285543
NET CASH INCOME	154.90	9.93	794052
NET CASH INCOME/N$100 TOTAL CAPITAL INVESTMENT	22.38		
"TOTAL BENEFITS"*/N$100 TOTAL CAPITAL INVESTMENT	79.33		
"TOTAL BENEFITS"*/HECTARE	35.19		

* "Total Benefits" = all of Net Cash Income, Salaries and Wages, Licences and Duties, Rental and Royalties.

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TABLE Sa7: STATIC ECONOMIC MODEL (AT FULL PRODUCTION)

ITEM	UNITS		TOTAL
Concession Extent	Hectares		80000
Concession Stock	Large Stock Units (LSU)		5126
Total Capital Requirement	N$		3360171
Economic Depreciation Cost	N$		257874
Foreign Financing (Prorated)	N$		72878
Foreign Amortisation	N$		18219
Foreign Capital Replacement Provision	N$		54658
Foreign Interest Cost	N$		83889
Domestic Interest Cost	N$		251667
ECONOMIC BENEFITS	N$/LSU	N$/HECTARE	N$
Gross Income	897.23	57.49	4599467
ECONOMIC COSTS			
DOMESTIC COMPONENT			
Shadow Unskilled Citizen Wages	8.74	0.56	44800
Other Citizen Wages	140.88	9.03	722176
Other Domestic Economic Costs	32.83	2.10	168291
SUBTOTAL DOMESTIC COMPONENT	182.45	11.69	935267
TRADABLE COMPONENT			
Foreign Remuneration	78.65	5.04	403200
Foreign Services	213.09	13.65	1092374
Foreign Interest	16.36	1.05	83889
Foreign Lease Payments	0.00	0.00	0
Foreign Rentals	0.00	0.00	0
Foreign Net Income	41.05	2.63	210424
Other Tradable Economic Costs	52.73	3.38	270310
SUBTOTAL TRADABLE COMPONENT	401.89	25.75	2060197
TOTAL ECONOMIC COSTS	584.34	37.44	2995463
GROSS VALUE ADDED TO NATIONAL INCOME	312.90	20.05	1604004
NET VALUE ADDED (Excluding Depreciation)	262.59	16.83	1346130
STATISTICAL GROSS VALUE ADDED	462.52	29.64	2370980
DOMESTIC RESOURCE COST RATIO	0.47		
NET VALUE ADDED/N$100 TOTAL CAPITAL COST	40.06		
CAPITAL COST/EMPLOYMENT OPPORTUNITY CREATED	280014		
NUMBER OF EMPLOYMENT OPPORTUNITIES/1000 HA.	0.15		

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TABLE Sa8: CAPITAL PHASING, DEPRECIATION SCHEDULE AND CALCULATION OF RESIDUAL VALUE

ITEM	LIFE (Yrs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
DEPRECIABLE ASSETS												
"Forty Year" Items	40											
Total Expenditure		1177050										
Phased Expenditure		706230	470820	0	0	0	0	0	0	0	0	0
Depreciation		17656	29426	29426	29426	29426	29426	29426	29426	29426	29426	29426
Residual value		706230	1159394	1129968	1100542	1071116	1041689	1012263	982837	953411	923984	894558
"Twenty Year" Items	20											
Total Expenditure		0										
Phased Expenditure		0	0	0	0	0	0	0	0	0	0	0
Depreciation		0	0	0	0	0	0	0	0	0	0	0
Residual value		0	0	0	0	0	0	0	0	0	0	0
"Fifteen Year" Items	15											
Total Expenditure		682500										
Phased Expenditure		409500	273000	0	0	0	0	0	0	0	0	0
Depreciation		27300	45500	45500	45500	45500	45500	45500	45500	45500	45500	45500
Residual value		409500	655200	609700	564200	518700	473200	427700	382200	336700	291200	245700
"Six Year" Items	6						6					
Total Expenditure		721708						721708				
Phased Expenditure		505196	216512	0	0	0	0	505196	216512	0	0	0
Depreciation		84199	120285	120285	120285	120285	120285	120285	120285	120285	120285	120285
Residual value		505196	637509	517224	396939	276655	156370	541281	637509	517224	396939	276655
"Four Year" Items	4											
Total Expenditure		319200				319200				319200		
Phased Expenditure		319200	0	0	0	319200	0	0	0	319200	0	0
Depreciation		79800	79800	79800	79800	79800	79800	79800	79800	79800	79800	79800
Residual value		319200	239400	159600	79800	319200	239400	159600	79800	319200	239400	159600
NON DEPRECIABLE ASSETS												
Stock	-											
Phased Expenditure		0	0	0	0	0	0	0	0	0	0	0
Residual value		0	0	0	0	0	0	0	0	0	0	0
Working Capital	-											
Phased Expenditure		0	0	0	0	0	0	0	0	0	0	0
TOTAL PHASED CAPITAL EXPENDITURE												
Domestic Component		706230	470820	0	0	0	0	0	0	0	0	0
Tradable Component		1233896	489512	0	0	319200	0	505196	216512	319200	0	0
Total Financial Value		1940126	960332	0	0	319200	0	505196	216512	319200	0	0
Total Economic Value		1792602	880836	0	0	301133	0	476602	204258	301133	0	0
TOTAL ASSET RESIDUAL VALUE												
Domestic Component		706230	1159394	1129968	1100542	1071116	1041689	1012263	982837	953411	923984	894558
Tradable Component		1233896	1532109	1286524	1040939	1114555	868970	1128581	1099509	1173124	927539	681955
Financial Value		1940126	2691503	2416492	2141481	2185670	1910659	2140844	2082345	2126535	1851524	1576513
Economic Value		1792602	2477252	2219378	1961504	2004764	1746890	1965617	1912001	1955261	1697387	1439513

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TABLE Sa9: LOAN FINANCING SCHEDULE

ITEM	PERIOD (Yrs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
LONG TERM LOANS												
TWENTY YEAR LOAN	20											
Total Expenditure		294263										
Loan Disbursements		176558	117705	0	0	0	0	0	0	0	0	0
Loan Payments		20738	34564	34564	34564	34564	34564	34564	34564	34564	34564	34564
Amortisation		8828	14713	14713	14713	14713	14713	14713	14713	14713	14713	14713
Interest Payments		11911	19851	19851	19851	19851	19851	19851	19851	19851	19851	19851
Loans Outstanding		176558	285435	270722	256008	241295	226582	211869	197156	182443	167730	153017
FIFTEEN YEAR LOAN	15											
Total Expenditure		170625										
Loan Disbursements		127969	42656	0	0	0	0	0	0	0	0	0
Loan Payments		16825	22433	22433	22433	22433	22433	22433	22433	22433	22433	22433
Amortisation		8531	11375	11375	11375	11375	11375	11375	11375	11375	11375	11375
Interest Payments		8293	11058	11058	11058	11058	11058	11058	11058	11058	11058	11058
Loans Outstanding		127969	162094	150719	139344	127969	116594	105219	93844	82469	71094	59719
SIX YEAR LOAN	6						6					
Total Expenditure		180427						180427				
Loan Disbursements		126299	54128	0	0	0	0	126299	54128	0	0	0
Loan Payments		28999	41427	41427	41427	41427	41427	41427	41427	41427	41427	41427
Amortisation		21050	30071	30071	30071	30071	30071	30071	30071	30071	30071	30071
Interest Payments		7949	11356	11356	11356	11356	11356	11356	11356	11356	11356	11356
Loans Outstanding		126299	159377	129306	99235	69164	39093	135320	159377	129306	99235	69164
FOUR YEAR LOAN	4											
Total Expenditure		79800				79800				79800		
Loan Disbursements		79800	0	0	0	79800	0	0	0	79800	0	0
Loan Payments		25175	25175	25175	25175	25175	25175	25175	25175	25175	25175	25175
Amortisation		19950	19950	19950	19950	19950	19950	19950	19950	19950	19950	19950
Interest Payments		5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225
Loans Outstanding		79800	59850	39900	19950	79800	59850	39900	19950	79800	59850	39900
SHORT TERM LOANS												
Working Capital	1											
Overdraft		647862	647862	647862	647862	647862	647862	647862	647862	647862	647862	647862
Interest Payments		97179	97179	97179	97179	97179	97179	97179	97179	97179	97179	97179
TOTAL LONG TERM LOAN DISBURSMENTS												
Domestic Component		382969	160867	0	0	59850	0	94724	40596	59850	0	0
Foreign Component *		135316	56840	0	0	21147	0	33469	14344	21147	0	0
TOTAL LONG TERM LOAN AMORTISATION												
Domestic Component		43769	57082	57082	57082	57082	57082	57082	57082	57082	57082	57082
Foreign Component *		15465	20169	20169	20169	20169	20169	20169	20169	20169	20169	20169
TOTAL INTEREST PAYMENTS												
Domestic Component		97918	108501	108501	108501	108501	108501	108501	108501	108501	108501	108501
Foreign Component *		34598	38337	38337	38337	38337	38337	38337	38337	38337	38337	38337
TOTAL LOANS OUTSTANDING												
Domestic Component		382969	500067	442985	385903	388671	331589	369231	352745	355513	298431	241349
Foreign Component *		135316	176690	156521	136352	137330	117161	130462	124637	125615	105446	85277

* Economic Values

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TABLE Sa10: FINANCIAL ANALYSIS - 5 YEARS (N$, 2006)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EXPENDITURE						
Capital Expenditure	1940126	960332	0	0	319200	0
Variable Expenditure	179582	1077492	1795820	1795820	1795820	1795820
Overhead Expenditure	1858507	1858507	1858507	1858507	1858507	1858507
TOTAL EXPENDITURE	3978215	3896332	3654327	3654327	3973527	3654327
INCOME						
Gross Income	0	2437708	4387874	4875416	4875416	4875416
Asset Residual Value	0	0	0	0	0	1910659
TOTAL INCOME	0	2437708	4387874	4875416	4875416	6786075
NET BENEFIT/COST	-3978215	-1458624	733547	1221089	901889	3131748

FINANCIAL RATE OF RETURN (FRR) OVER 5 YEARS	=	2.58%	
NET PRESENT VALUE (NPV) @	8.00%	=	-866875

TABLE Sa11: FINANCIAL ANALYSIS - 7 YEARS (N$, 2006)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
EXPENDITURE								
Capital Expenditure	1940126	960332	0	0	319200	0	505196	216512
Variable Expenditure	179582	1077492	1795820	1795820	1795820	1795820	1795820	1795820
Overhead Expenditure	1858507	1858507	1858507	1858507	1858507	1858507	1858507	1858507
TOTAL EXPENDITURE	3978215	3896332	3654327	3654327	3973527	3654327	4159523	3870840
INCOME								
Gross Income	0	2437708	4387874	4875416	4875416	4875416	4875416	4875416
Asset Residual Value	0	0	0	0	0	0	0	2082345
TOTAL INCOME	0	2437708	4387874	4875416	4875416	4875416	4875416	6957761
NET BENEFIT/COST	-3978215	-1458624	733547	1221089	901889	1221089	715893	3086922

FINANCIAL RATE OF RETURN (FRR) OVER 7 YEARS	=	8.07%	
NET PRESENT VALUE (NPV) @	8.00%	=	14570

TABLE Sa12: FINANCIAL ANALYSIS - 10 YEARS (N$, 2006)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
EXPENDITURE											
Capital Expenditure	1940126	960332	0	0	319200	0	505196	216512	319200	0	0
Variable Expenditure	179582	1077492	1795820	1795820	1795820	1795820	1795820	1795820	1795820	1795820	1795820
Overhead Expenditure	1858507	1858507	1858507	1858507	1858507	1858507	1858507	1858507	1858507	1858507	1858507
TOTAL EXPENDITURE	3978215	3896332	3654327	3654327	3973527	3654327	4159523	3870840	3973527	3654327	3654327
INCOME											
Gross Income	0	2437708	4387874	4875416	4875416	4875416	4875416	4875416	4875416	4875416	4875416
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	1576513
TOTAL INCOME	0	2437708	4387874	4875416	4875416	4875416	4875416	4875416	4875416	4875416	6451929
NET BENEFIT/COST	-3978215	-1458624	733547	1221089	901889	1221089	715893	1004576	901889	1221089	2797601

FINANCIAL RATE OF RETURN (FRR) OVER 10 YEARS	=	11.86%	
NET PRESENT VALUE (NPV) @	8.00%	=	1106156

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA SAFARI HUNTING - NGAMILAND 2006 - BASE CASE

TABLE Sa13: ECONOMIC ANALYSIS - 5 YEARS (N$,2006)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ECONOMIC COSTS						
Capital Expenditure	1792602	880836	0	0	301133	0
Unskilled Wages	44800	44800	44800	44800	44800	44800
Other Domestic Costs	712373	890467	890467	890467	890467	890467
Tradable Costs	174766	1048598	1747664	1747664	1747664	1747664
Foreign Amortisation	15465	20169	20169	20169	20169	20169
Foreign Profits	0	14730	168339	210424	210424	210424
Foreign Loans Outst.	0	0	0	0	0	117161
TOTAL COSTS	2740007	2899600	2871439	2913524	3214657	3030685
ECONOMIC BENEFITS						
Gross Income	0	2299734	4139521	4599467	4599467	4599467
Asset Residual Value	0	0	0	0	0	1746890
Foreign Financing	135316	56840	0	0	21147	0
TOTAL BENEFITS	135316	2356573	4139521	4599467	4620614	6346357
NET BENEFIT/COST	-2604691	-543026	1268082	1685944	1405958	3315672

ECONOMIC RATE OF RETURN (ERR) OVER 5 YEARS		=	28.47%
NET PRESENT VALUE (NPV) @	8.00%	=	2414862

TABLE Sa14: ECONOMIC ANALYSIS - 10 YEARS (N$, 2006)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
ECONOMIC COSTS											
Capital Expenditure	1792602	880836	0	0	301133	0	476602	204258	301133	0	0
Unskilled Wages	44800	44800	44800	44800	44800	44800	44800	44800	44800	44800	44800
Other Domestic Costs	712373	890467	890467	890467	890467	890467	890467	890467	890467	890467	890467
Tradable Costs	174766	1048598	1747664	1747664	1747664	1747664	1747664	1747664	1747664	1747664	1747664
Foreign Amortisation	15465	20169	20169	20169	20169	20169	20169	20169	20169	20169	20169
Foreign Profits	0	14730	168339	210424	210424	210424	210424	210424	210424	210424	210424
Foreign Loans Outst.	0	0	0	0	0	0	0	0	0	0	85277
TOTAL COSTS	2740007	2899600	2871439	2913524	3214657	2913524	3390125	3117781	3214657	2913524	2998800
ECONOMIC BENEFITS											
Gross Income	0	2299734	4139521	4599467	4599467	4599467	4599467	4599467	4599467	4599467	4599467
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	1439513
Foreign Financing	135316	56840	0	0	21147	0	33469	14344	21147	0	0
TOTAL BENEFITS	135316	2356573	4139521	4599467	4620614	4599467	4632937	4613811	4620614	4599467	6038980
NET BENEFIT/COST	-2604691	-543026	1268082	1685944	1405958	1685944	1242812	1496030	1405958	1685944	3040180

ECONOMIC RATE OF RETURN (ERR) OVER 10 YEARS		=	34.51%
NET PRESENT VALUE (NPV) @	8.00%	=	5709412

FINANCIAL/ECONOMIC MODEL - HIGH QUALITY AREA SAFARI HUNTING - NGAMILAND 2006 - BASE CASE

TABLE Sa15: SUMMARY OF RESULTS

ITEM	UNITS	TOTAL
Concession Extent	Hectares	80000
Concession Stock	Large Stock Units (LSU)	5126
Annual Visitor Days (VD)	Number	362

ITEM	% of TCI	N$/VD	N$/LSU	N$/HECTARE	N$
Total Financial Capital (TCI)	-	9815.55	692.18	44.35	3548320
Financial Gross Income	137.40%	13486.63	951.07	60.94	4875416
Variable Financial Costs	-	4967.69	350.32	22.45	1795820
Fixed Financial Costs	-	6322.39	445.85	28.57	2285543
Net Cash Income	22.38%	2196.55	154.90	9.93	794052
Land Rental	-	608.58	42.92	2.75	220000
Resource Royalty	-	539.47	38.04	2.44	195017
FRR (@ 10 Years)	-	-	-	-	11.86%
FNPV (@ 8%, @ 10 Years)	-	-	-	13.83	1106156
Total Economic Capital	-	9295.08	655.48	42.00	3360171
Economic Gross Income	136.88%	12723.28	897.23	57.49	**4599467**
Economic Costs	89.15%	8286.21	584.34	37.44	2995463
Incremental Gross Value Added	47.74%	4437.08	312.90	20.05	**1604004**
Incremental Net Value Added	40.06%	3723.74	262.59	16.83	1346130
Statistical Gross Value Added	70.56%	6558.73	462.52	29.64	**2370980**
ERR (@ 10 Years)	-	-	-	-	34.51%
ENPV (@ 8%, @ 10 Years)	-	-	-	71.37	5709412
Economic Capital Cost/Job	-	-	-	-	280014
Domestic Resource Cost Ratio	-	-	-	-	0.47

Policy Analysis Matrix	: Effects of Policy / Market Imperfections	: on Output	275949
		: on Tradable Inputs	615758
		: on Domestic Factors	-1443784
	: Net Effects of Policy / Market Imperfections	: on Annual Net Income	-552078
		: on Net Present Value (10 Years)	-4603255

17 APPENDIX 5. THE SAM MODEL

The SAM framework

The framework for the Social Accounting Matrix (SAM) was first developed in the 1950s as an extension of the core national accounts in order to integrate economic and social aspects of development (Pyatt and Round, 1985). The SAM began to be more widely used for policy in the 1970s when it became clear that economic development, measured by growth in GDP, could not ensure poverty reduction, and that a tool to monitor income distribution was needed. The SAM is now included as part of the 1993 revision of the System of National Accounts, the framework used by virtually all countries for compiling national accounts (UN, 1993).

The SAM is a comprehensive, economy-wide database using a double-entry bookkeeping approach to present the data in a square table format. Data from the National Accounts and statistics about households and other institutions are used to construct accounts for

- Supply of products from imports and domestic production
- Production structure of each industry
- Generation of income by each industry
- Redistribution of incomes among institutions, for example transfers among different groups of households, transfers from government to households, taxes paid by households and enterprises to government, etc.
- Detailed expenditure patterns of households and other institutions
- Saving and investment
- Transactions with the rest of the world (ROW), imports and exports

Each account is represented by a row and column, as seen in Figure 1: reading the SAM across a row shows the incomes or sales revenue of an account, while reading the SAM down a column shows the expenditures or outlays of that account. The principle of accounting requires that total revenue (row total) equals total expenditure (column total). A Basic SAM was constructed for Botswana for the year 2002-2003 (Thurlow, 2006). The Basic SAM has been modified for the analysis of economic activities in the Okavango Delta by expanding the number of Agricultural activities from 3 industries to 8 and expanding tourism related activities from 1 to 12.

Two additional categories of income were added in order to better represent the benefits of local communities from the resources of the Delta: rents and royalties for use of traditional land for tourism, and mixed income from agriculture in the Delta communal land. These are described below.

Table A5.1 Structure of a Social Accounting Matrix

		PRODUCTION ACCOUNTS		PRIMARY INCOME	INSTITUTION ACCOUNTS			CAPITAL ACCOUNT	REST OF WORLD ACCOUNT	TOTAL INCOMES
		Commodities	**Activities**	**Factor Payments**	**Households**	**Enterprises**	**Government**			
PRODUCTION	**Commodities**	Trade margins	Intermediate use of commodities		Household Consumption Expenditure		Government Consumption Expenditure	Investment & Change in Inventories	Exports	Total use of commodities
	Activities	Domestic supply								Domestic supply of commodities
	Factors		Net Value Added						Factor Income from Abroad	Factor income
INSTITUTIONS	**Households**			Labour incomes	Inter-household transfers	Enterprise income distributed to households	Government Transfers to Households		Remittances from Abroad	Household income
	Enterprises			Undistributed profits			Transfers to Enterprises		Enterprise Income from abroad	Enterprise Income
	Government	Taxes less subsidies on products	Taxes less subsidies on production	Taxes on labour and profits	Taxes on household income & property	Direct taxes on Enterprises			Government Income from World	Government revenue
CAPITAL ACCOUNT			Consumption of Fixed Capital		Household Saving	Enterprise savings	Government Saving		Capital Account BoP	Total savings
REST OF WORLD ACCOUNT		Imports		Factor payments abroad	Remittances abroad	Transfers abroad	Transfers abroad			Total imports
TOTAL EXPENDITURES		Total Commodity Supply	Total domestic output	Total factor outlay	Household expenditure	Enterprise Expenditure	Government expenditure	Capital expenditure	Total exports	

Explanation of main accounts of the SAM

The detailed components of the SAM are listed in Table A1. This section also includes a description of how the Basic SAM was modified for the Ramsar site analysis.

Table A5.2 Detailed components of the SAM

Component	Extended SAM for Ramsar site
Products (48)	4 Agricultural products 5 Agricultural products produced in the Delta 1 Mining 18 Manufactured goods, utilities & construction 9 Services (excluding services related to the Delta) 10 products related to tourism in the Delta, mainly accommodation and transportation services Trade margins
Activities (38)	3 Agricultural activities 5 Agricultural activities in the Delta 1 Mining 12 Manufacturing, utilities & construction 7 Services (excluding services related to the Delta) 10 activities related to tourism in the Delta, mainly accommodation and transportation services
Factors of production (11)	6 Labour • City skilled labour, unskilled labour • Village skilled labour, unskilled labour • Rural skilled labour, unskilled labour Gross operating surplus, mining Gross operating surplus, non-mining Taxes net of subsidies on production Mixed Income in Traditional Agriculture and natural-resource based activities Rents & royalties on traditional land used for tourism
Institutions (13)	9 Households: • City, 3 income groups • Town, 3 income groups • Rural, 3 income groups 3 Enterprises: mining, public, private (non-mining) Government
Capital (1)	Savings & Investment
Rest of World (1)	Imports & Exports

Products and Activities. The SAM distinguishes products (markets for the goods and services) from activities, that is, the domestic production of commodities by industries. This distinction is important in some economies because some activities may produce more than one commodity. For example, farming activities may produce both livestock and crop products, or the fishing industry may produce both fish and processed fish products. Reading down the column of the commodity account shows how much of each commodity is supplied by domestic activities (the detailed SAM will show this for each activity or industry) and how much is imported from the Rest of the World (ROW). There are two additional entries in this column:

- Trade margin, which is the difference between the price received by the producer and the price paid by the purchaser. This difference is the 'markup' added by wholesale or retail traders. Similar margins for transportation from producer to purchaser and other associated services (insurance) are also included, reflecting the cost of moving a product from the producer (or, in the case of imports, from the border) to the purchaser.
- Taxes less subsidies on products include taxes like the fuel levy or import tariffs on specific products.

The sum of this column is the total supply of commodities available in the economy, valued at the prices purchasers pay. Reading across the row shows the uses for all commodities: as inputs to domestic production activities, and to final users including households, government, investment and ROW (exports). Total use of commodities is equal to total supply.

The activity accounts show production by domestic industry: across the activity account rows, the amount of each commodity an industry supplies, down the activity account column, the cost of production which includes the inputs required for production, 'factor inputs' and taxes on production.

Both product and activity accounts are extended from the Basic SAM by including
Agricultural activities and products

- Dryland crop farming
- Molapo crop farming
- Livestock in villages
- Livestock in cattle posts
- Other natural-resource based activities (pottery, fuelwood, grass and thatch, etc.)

Tourism-related activities and products

- Lodges
- Hunting camps
- Mobile safaris
- Guest houses
- Hotels in the Delta
- Restaurants & Bars in the Delta
- Transportation (air charter)
- Travel agent services
- Shopping by tourists
- Other CBNRM-related goods produced in the Delta and purchased by tourists

These have been described in greater detail earlier in the report.

Factor accounts. Factor accounts consist of factor inputs to production: labour, capital/mixed income, and rent on property. Labour is disaggregated into 6 types by skill level and location. Skilled labour consists of those classified as Professionals, Managerial workers and Clerical workers. Unskilled workers include those classified as Manual and Unskilled workers. Workers are further differentiated by place of employment: City, Town or Rural.

Income to capital distinguishes the gross operating surplus (GOS) of Mining enterprises and GOS of Non-mining enterprises. The earnings of the self-employed, such as farmers, are called 'mixed income' because the surplus of sales revenue over input costs includes both a payment for their own labour as well as a payment for capital inputs. The Ramsar site SAM includes a category of mixed income for farmers and other producers in the Okavango Delta. An additional category of income is created to represent the rent and royalties received by local communities and government agencies for use of their land for tourism.

Institution accounts. There are three major categories of institutions: households, enterprises and government. Households obtain income (across the row) by supplying labour as a factor in production, but also receive transfers from other households, from government, from ROW, and distributed earnings (interest and dividend payments) from enterprises. The expenditure of households (down the column) includes purchases of goods and services for consumption, transfers made to other households, taxes paid to government, remittances to ROW and savings. The Basic SAM distinguished 30 types of household by income decile (10) and location (3). These were aggregated into 9 types of households for the Ramsar site SAM, 3 income groups for each of the 3 locations (City, Town, and Village). Low income households cover those falling into the first 3 income deciles; middle income include those in deciles 4-7, and high income households include those in deciles 8-10.

Enterprises receive income from factor markets for the capital they provide and use the income by distributing it to households and ROW, paying taxes, and saving (retained earnings). Three types of enterprises are represented here: Mining, Non-mining, and Public enterprises. Government receives

income from various kinds of taxes and transfers from ROW, which include development assistance; like the other institutions, government uses its income for purchases of goods and services, transfers, and saving.

Capital account. The capital account consists of Savings across the row and expenditures for Investment down the column.

Rest of the World account. The economy's interactions with ROW are represented in the last row and column. ROW obtains income from sales of imports (of goods, services and factors) to the domestic economy; ROW spends income in the domestic economy from its purchase of Botswana's exports, the use of Botswana factors of production (labour and capital), transfers and foreign net borrowing/lending, which constitutes the balance of payments.

Data sources for the SAM

The data sources, adjustments and assumptions used to construct the Basic SAM are described in (Thurlow, 2006). Here, the data used for the expansion of the Basic SAM into the Ramsar site SAM are described. The Ramsar site SAM required additional data about Agricultural activities and Tourism activities. Most of this information was collected by surveys described earlier in the report.

The Basic SAM included only one type of accommodation, which was combined with Restaurants, in the single product/activity category, Hotels & restaurants. This industry, Hotels & restaurants, was split by estimating the input structures for each component based on analysis done for a similar Namibian study. Then input structures for the remaining categories of tourism-related activities were estimated partly from surveys conducted in the Delta and partly based on more detailed information collected in an earlier Namibian survey by Anton Cartwright for a study of Community-Based Natural Resources Management. The input structures provided information on intermediate consumption of goods and services, as well as labour inputs, operating surplus, and rents/royalties paid to communities for use of land in communal areas.

SAM Multiplier Model for Tourism

The SAM itself is simply a database that provides a 'snapshot' of the economy at a point in time. To use this database for analysis, the SAM must be transformed into a model. SAMs are used in many types of economic models, but the two most common approaches to SAM-based modeling are multiplier analysis and computable general equilibrium (CGE) modeling. Multiplier analysis is used either to analyse the present economy to gain a better understand of the linkages, or for impact analysis of the effect of policy change under the assumption that prices, consumption and trade coefficients remain constant. For analysis of changes or estimates of policy impacts, multiplier analysis can also be useful, although CGE models are often used because they are better able to estimate the behavioral response of different groups to changes.

For this study, the contribution of Okavango Delta activities to the Botswana economy in 2005, multiplier analysis is appropriate. The multiplier analysis used accounting multipliers (Pyatt and Round, 1984):

(1) $$x = Ax + y$$

(2) $$x = (I - A)^{-1} y$$

Where
x is a vector of outputs for every component of the SAM
y is a vector of exogenous demands for goods and services. Enterprises, government, investment and exports are treated as exogenous sectors.
I is an identity matrix, a square matrix with 1's along the diagonal and 0's everywhere else
A is a matrix of coefficients for the endogenous sectors. Coefficients are calculated by dividing each entry in a given SAM column, *j,* by the sum for that column, (x_j). This matrix includes all income

generation and household expenditure, so the induced effects of incomes can be included in the multiplier analysis.

Equation 1 says that output, *x*, for each sector is the sum of all goods needed to satisfy endogenous demands (*Ax*) plus exogenous demand (*y*).

Equation 2 is used to calculate the impacts of exogenous demand, *y*. In this case, the level of Ramsar site Expenditures for Tourism and Agricultural production is treated as an exogenous expenditure. This allows one to calculate all the impacts of Ramsar site Expenditures independently from any other exogenous expenditures in the economy.