CHAPTER 5

TOTAL ECONOMIC VALAUE OF THE OKAVANGO DELTA

5.1 Introduction

In this chapter, the total estimated economic value of the Okavango Delta is presented under different scenarios and assumptions. In most cases two scenarios have been developed. Actual estimates are made, while conservative estimates are made under various assumptions. Estimates are made of compositional accounts of selected herbivores, functional or direct use value of herbivores and plants, water supply, indirect use values of livestock grazing, milk production, honey production and carbon sequestration. Estimates of non-use values are made for tourists and households. All estimates are also presented on per hectare basis.

5.2 Accounting for stock of wild herbivores and vegetation of the Okavango Delta region: Composition values

5.2.1 Wild herbivores

The wildlife resources of Botswana are found within protected areas and wildlife management areas (WMAs). Protected areas refer to game reserves and national parks that are managed by the DWNP for the conservation of wild habitats, biological diversity and wildlife. Only non-consumptive uses such as wildlife viewing is allowed within protected areas. WMAs on the other hand, are areas that surround and connect protected areas, providing migratory corridors and buffer zones. Consumptive and non-consumptive exploitation of wildlife is carried out within WMAs (Government of Botswana, 2003c). To facilitate the administration of hunting in the country, the government established controlled hunting areas (CHAs) within the WMAs.

The annual wildlife census compiled by the Department of Wildlife and National Parks provided the data base for the construction of the compositional accounts for selected herbivore species. Two scenarios were developed based on hunting license fees for various animal species. In the first scenario, the valuation of the composition of selected herbivores was carried out using hunting license fees paid by non citizens, while in the second scenario the valuation was carried out using hunting license fees paid by citizens. The hunting fees paid by citizens are lower than hunting fees paid by non-citizens. In both scenarios, the estimated values were for traded species only. In a perfect market system, the price of a given animal species would reflect its total economic value or the sum of direct use value, indirect use value and non-use value. Accordingly, an animal species such as an elephant has direct use values (meat, hides, ivory, live animals, tourism, recreation), indirect use values (for example, contribution to biodiversity or nutrient cycling), option values (all future values) and non-use values (existence, bequest and spiritual values). The hunting license fees should reflect the scarcity values of the traded animal species. However, since the prices are controlled by the Government of Botswana, they are subject to change depending on management situations as seen by government of Botswana. For instance, hunting license fees paid by citizens and non citizens have been very lower for a long time when compared to the new schedule of prices introduced in 2001 (Arntzen, 1998). The new schedule of hunting license fees is a result of a recent review of old fees by the government of Botswana. The current prices are comparable to prevailing prices in the region, particularly those in Zimbabwe, South Africa and Namibia.

Scenario 1: compositional values of wild herbivores using citizen prices

Table 6 shows the compositional accounts for different herbivore wildlife species during 2003. The change in the population of wildlife species is expected to be brought about by natural increase (birth) and decrease (death) and man-made increase (introductions) or decrease (hunting and poaching). Table 6 also shows the values of each species during the same year.

Table 6: Estimates of stocks of traded wild herbivores using non-citizen prices

Species name	Common name	Number of animals	Area size (ha)	Density (animal/ha)	Market price (Pula)	Value (Pula)	Value (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)	Species status
Loxodonta Africana	Elephant	57 381	10 822 000	0.00530	20 000	114 762 000	23 417 186.1	106.05	21.64	CITES appendix 1
Equus burchelli	Zebra	17 447	10 822 000	0.00161	5 000	87 235 000	17 800 301.75	80.61	16.45	Abundant
Phacochoerus aethiopicus	Warthog	1 148	10 822 000	0.00011	500	5 740 000	1 171 247	0.53	0.12	Abundant
Taurotragus oryx	Eland	360	10 822 000	0.00003	2 500	90 000	18 364.5	0.0083	0.0017	Abundant
Tragelaphus strepsiceros	Kudu	3 693	10 822 000	0.00034	1 000	3 693 000	753 556.65	0.34	0.069	Abundant
Tragelaphus spekei	Sitatunga	167	10 822 000	0.00002	5 000	985 000	200 989.25	0.099	0.020	Abundant
Oryx gazelle	Gemsbok	7 191	10 822 000	0.00066	2 500	17 977 500	3 668 308.88	1.66	0.34	Abundant
Hippotrugus niger	Sable	949	10 822 000	0.00009	5 000	4 745 000	968 217.25	0.44	0.090	Partially protected
Kobus leche	Lechwe	48 628	10 822 000	0.00449	1 000	48 628 000	9 922 543.4	4.49	0.92	CITES appendix II
Redunca arundinum	Reedbuck	67	10 822 000	0.00001	1500	100 500	20 507.025	0.0093	0.0019	Protected
Damaliscus lunatus	Tsessebe	4 560	10 822 000	0.00042	3 000	13 680 000	2 791404	1.26	0.26	CITES appendix II
Alcelaphus buselaphus	Hartebeest	414	10 822 000	0.00004	1 000	414 000	84 474.7	0.038	0.0078	Abundant
Connochaetes taurinus	Wildebeest	5 765	10 822 000	0.00053	2 500	14 412 500	2 940 870.63	1.33	0.27	Abundant
Aepyceros melampus	Impala	26 419	10 822 000	0.00224	500	132 095 00	2 695 398.48	1.22	0.24	Abundant
Antidorcas marsupialis	Springbok	1 417	10 822 000	0.00013	400	566 800	115 655.54	0.052	0.011	Abundant
Sylvicapra grimmia	Duiker	973	10 822 000	0.0009	300	291 900	59 562.20	0.027	0.0055	Abundant
Raphicerus campestris	Steenbok	3 391	10 822 000	0.00031	300	1 017 300	207 580.065	0.094	0.019	Abundant
Syncerus caffer	Buffalo	17 697	10 822 000	0.00164	5 000	88 485 000	1 8 055 364.25	8.18	1.67	Abundant
Papio ursinus	Baboon	3 037	10 822 000	0.00028	200	607 400	123 939.97	0.056	0.011	Abundant
Total		**200 704**	10 822 000			**1 444 992 400**	**294 850 699.2**	**133.5236**	**42.14**	

Source: Own calculations based on Aerial Census of Animals in Botswana (2003), Single Game License Hunting Fees

Using the license fees paid by non-citizens, the total value of the standing stock of selected wildlife herbivore species was estimated at P1 444 992 400[1] (US$294 850 699.2) (Table 6). The total value is an underestimation because some of protected herbivore species such as the rhino and giraffe are not traded. The total value per hectare was estimated to be P133.5/ha (US$27.24/ha). The value of wildlife herbivores per hectare for individual herbivore species ranged from P106.05/ha (US$21.64/ha) for elephant (*Loxodonta africana*), to P0.093/ha (US$0.018/ha) for reedbuck (*Redunca arundinum*). The low value per hectare for *Redunca arundinum* is a result of the low population of these animal species. Currently, *Redunca arundinum* is a protected animal species.

Scenario 2: Compositional value of wild herbivores using non-citizen prices

In the second scenario, the compositional value was estimated at P535 881700 (US$109 000000), while the values per hectare was estimated at P49.5/ha (Table 7). The corresponding values in the first scenario are more than two times the size of the values in the first scenario. Considering that hunting license fees paid by non citizens are closer to market values of animals (Kaisara personal communication, 2004), the valuation of wild herbivores using hunting license fees paid by citizens leads to a gross undervaluation of these resources which may lead to unsustainable utilization of wildlife resources.

[1] 1Botswana Pula = 0.204050US$ (5/7/2004)

Table 7: **Estimates of compositional values of selected wild herbivores using citizen prices**

Species name	Common name	Number of animals	Area size (ha)	Density (animal/ha)	Market price (Pula)	Value (Pula)	Value (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)	Status
Loxodonta Africana	Elephant	57 381	10 822 000	0.00530	8 000	459 048 000	93 668 744	42.42	8.66	CITES appendix 1
Equus burchelli	Zebra	17 447	10 822 000	0.00161	1 000	17 447 000	3 560 060	1.61	0.33	Abundant
Phacochoerus aethiopicus	Warthog	1 148	10 822 000	0.00011	150	172 200	35 137.41	0.012	0.0024	Abundant
Taurotragus oryx	Eland	360	10 822 000	0.00003	700	252 000	51 420.6	0.023	0.0047	Abundant
Tragelaphus strepsiceros	Kudu	3 693	10 822 000	0.00034	300	1 107 900	226 067	0.10	0.020	Abundant
Tragelaphus spekei	Sitatunga	167	10 822 000	0.00002	1 500	250 500	51 114.53	0.023	0.0047	Abundant
Oryx gazelle	Gemsbok	7 191	10 822 000	0.00066	700	5 033 700	1 027 126	0.47	0.096	Abundant
Hippotrugus niger	Sable	949	10 822 000	0.00009	1 500	1 423 500	290 465.2	0.13	0.027	Partially protected
Kobus leche	Lechwe	48 628	10 822 000	0.00449	300	14 588 400	2 976 763	1.35	0.28	CITES appendix II
Redunca arundinum	Reedbuck	67	10 822 000	0.00001	500	33 500	6 835.68	0.0030	0.00061	Protected
Damaliscus lunatus	Tsessebe	4 560	10 822 000	0.00042	500	2 280 000	4 65 234	0.21	0.043	CITES appendix II
Alselaphus buselaphus	Hartebeest	414	10 822 000	0.00004	300	124 200	25 343.01	0.011	0.0022	Abundant
Connochaetes taurinus	Wildebeest	5 765	10 822 000	0.00053	500	2 882 500	5 88 174.1	0.27	0.055	Abundant
Aepyceros melampus	Impala	26 419	10 822 000	0.00224	150	3 962 850	808 619.5	0.37	0.075	Abundant
Antidorcas marsupialis	Springbok	1 417	10 822 000	0.00013	100	141 700	28 913.89	0.013	0.0027	Abundant
Sylvicapra grimmia	Duiker	973	10 822 000	0.00009	100	97 300	19 854.07	0.009	0.0018	Abundant
Raphicerus campestris	Steenbok	3 391	10 822 000	0.00031	100	339 100	69 193.36	0.031	0.0063	Abundant
Syncerus caffer	Buffalo	17 697	10 822 000	0.00164	1 500	26 545 500	5 416 609	2.45	0.50	Abundant
Papio ursinus	Baboon	3 037	10 822 000	0.00028	50	151 850	30 984.99	0.014	0.0029	Abundant
Total		**200 704**	10 822 000			**535 881 700**	**109 000 000**	**49.5**	**10.10**	

Source: Own calculations based on Aerial Census of Animals in Botswana (2003)

5.2.2 Vegetation

The Okavango Delta is characterized by high floristic diversity. Floristic species diversity can be measured in terms of species richness and evenness (*alpha* diversity), or in terms of habitat diversity (*beta* diversity) (Ellery and Tacheba, 2003). The species richness of the Okavango Delta is due to a number of factors including the range of habitats (perennial swamps, seasonal swamps, seasonal grasslands, intermittent flooded areas, and the dryland) the gradient in soil and water chemistry, which ranges from freshwater swamps to saline pan and the dynamic water flow patterns that occur over time scales (Ellery and Tacheba, 2003). Plant diversity of the Okavango Delta is made up of 134 families, 530 genera, 1256 species and 1299 taxa (Ellery and Tacheba, 2003). Gibbs-Russell (1987) cited in Ellery and Tacheba (2003) indicated that the density of species in the Delta is between 0.029 and 0.039 taxa.km^{-2} which is greater than for most of the Southern African biomes such as savannah, nama karroo and desert, and is similar to the grassland and succulents karoo biomes, but less than that for the fynbos. Gibbs-Russell (1987) cited also in SMEC (1989) indicated that species area ratio of the Okavango Delta is greater than even some of the world larger biomes such as Europe, Sudan, Eastern Northern America, Tropical Africa, West Tropical Africa, Australia, Tropical Asia, Brazil and Southern Africa. The plant growth forms of the Okavango Delta and number of recorded species are shown in Table 8.

Table 8: Identified growth forms and number of species in the Okavango Delta

Growth form	**Number of species**	**% of known total species (1259)**	**Status**[a]		
			Vulnerable	Low risk- nearly threatened	Low risk- least concern
Aquatic creepers	6	0.48	-	-	-
Emergent aquatic	82	6.5	*Eulophia angolensis, Eulophia latilabris*	-	-
Free floating aquatic	17	1.4	-	-	-
Floating leaved aquatic	12	0.95	-	-	-
Floating stemmed aquatic	5	0.4	-	-	-
Aquatic shrub	7	0.6	-		
Emergent & submerged aquatic	2	0.2	-	-	-
Submerged aquatic	27	2.1		-	-
Epiphyte	1	0.08	*Ansellia Africana*	-	-
Geophyte	2	0.2	-	-	-
Ground creeper	14	1.1	*Herpagophytum procumbens*	-	-
Graminoid	331	26.4	-	-	*Pycreus okavangensis*
Herb	383	30.5	-	-	-
Herbacious wetland plant	15	1.2	-	-	-
Herbaceous creeper	76	6.05	-	-	-
Herbaceous geophyte	30	2.4	-	-	-
Woody herb	4	0.3	-	-	-
Tree	67	5.3	*Acacia hebaclada*	-	-
Shrub/tree	33	2.6	-	*Boscia foetida*	-
Shrub/wood climber	4	0.3	-	-	-
Shrub	57	4.5	-	-	
Shrublet	36	2.9	-	-	-
Aquatic tree	3	0.2	-	-	-
Wood climber	4	0.3	-	-	-
Woody ground creeper	1	0.08	-	-	-
Herbaceous root parasite	2	0.2	-	-	-
Tolerance of salinity/alkalinity	1	0.08	-	-	-
Total	221				

Sources: Compiled from Ellery and Tacheba (2003, SMEC (1989), Golding (2002)

a = the species indicated does not occur in the Okavango Delta, but is either vulnerable , endangered or nearly threatened in other parts of Botswana: *Adenum boehmianum* (endangered), *Adenium oleifolium* (vulnerable), *Hoodia lugardi* (vulnerable), *Huernia levyi* (vulnerable), *Orbeopsis knobelii* (vulnerable),

Euphobia venteri (endangered), *Naaea minima* (vulnerable), *Anacampeeros rhodesiaca* (vulnerable), *Erythrophysa transvaalensis* (vulnerable), *Harpagophytum zeyheri* (nearly threatened).

Of the known floral growth forms, herbs contributed the highest numbers in species diversity, while epiphytes and woody ground creepers were the least diverse. In terms of species conservation status, two emergent aquatic plants, one epiphyte species, one ground creeper and one tree species, are vulnerable. One shrub/tree species is nearly threatened.

The vegetation composition was not valued because the number of individual plant species was not known. Only growth forms of plants occurring in the Okavango Delta are recorded. For instance, it is known that *Sclerocarya birrea,* a tree, or *Cyperus papyrus,* a graminoid, occur in the Okavango Delta, but data showing the number of specimens of *Sclerocarya birrea* or *Cyperus papyrus* plants in the Okavango Delta does not exist. Further, no data exists showing the density of plant species which could be used to compute the number of specimen of species.

5.3 Direct use values from the Okavango Delta

5.3.1 Wild herbivores

The determination of direct use values of wild herbivores was based on hunting license fees paid by citizen and non-citizens. The value of extraction in the first scenario was determined using hunting license fees paid by non-citizens, while values in the second scenario were determined using hunting license fees paid by citizens.

Scenario 1: Direct use value of wild herbivores using citizen prices

Individual animal species showed a range of extraction values and the value of extraction per hectare during 2003 as shown in Table 9. The extraction value was determined by multiplying the number wild herbivores in the hunting quota for 2003 by the hunting license fee for the particular animal species. The duiker (*Sylvicapra grimmia)*, the

warthog (*Phacochoerus aethiopicus*) and the Steenbok (*Raphicerus campestris*) had the highest rates of extraction, which were 26.8%, 21.35% and 18.35%, respectively. The rate of extraction was calculated by dividing the number of wild herbivores in the hunting quota for 2003 by the total standing stock for that particular species in 2003. In terms of the value per hectare, elephants had the highest value of P0.29/ha. Species such as the sable (*Hippotragus niger*), the Roan antelope (*Hippotragus equines*) are not extracted because they are partially or fully protected.

Table 9: Estimates of direct consumptive use values of selected wild herbivores during using non-citizen prices

	Common Name	Area (ha)	Total animals	Animals off-take	Extraction (%)	Price (Pula)	Total value (Pula)	Total value (US$)	Value/ha Pula/ha	Value/ha (US$)
Loxodonta Africana	Elephant	10 822 000	57 381	156	0.27	20 000	3120 000	6 36636	0.29	0.059
Equus burchelli	Zebra	10 822 000	17 447	106	0.61	5 000	530 000	108 146.5	0.049	0.010
Phacochoerus aethiopicus	Warthog	10 822 000	1 148	245	21.3	500	122 500	24 996.125	0.011	0.0022
Taurotragus oryx	Eland	10 822 000	360	29	8.1	2 500	72 500	14 793.625	0.0067	0.0014
Tragelaphus strepsiceros	Kudu	10 822 000	3 693	180	4.9	1 000	180 000	366 729	0.017	0.0035
Tragelaphus spekei	Sitatunga	10 822 000	167	0	0	5 000.	0	0	0	0
Oryx gazella	Gemsbok	10 822 000	7 191	38	0.53	2 500	95 000	19 384.75	0.0088	0.0018
Hippotrugus niger	Sable	10 822 000	949	0	0	5000	0	0	0	0
Kobus leche	Lechwe	10 822 000	48 628	296	0.61	10 00	296 000	60 398	0.0056	0.0011
Redunca arundinum	Reedbuck	10 822 000	67	0	0	1 500	0	0	0	0
Damaliscus lunatus	Tsessebe	10 822 000	4 560	398	8.7	3 000.	1 194 000	243 635.7	0.11	0.022
Alselaphus buselaphus	Hartebeest	10 822 000	414	40	9.7	1 000	40 000	8 162	0.0037	0.00076
Connochaetes taurinus	Wildebeest	10 822 000	5 765	132	2.3	2 500	330 000	67 336.5	0.030	0.0061
Aepyceros melampus	Impala	10 822 000	26 419	860	3.3	500	430 000	87 741.5	0.040	0.0082
Antidorcas marsupialis	Springbok	10 822 000	1 417	41	2.9	400	16 400	3 346.42	0.0015	0.00031
Sylvicapra grimmia	Duiker	10 822 000	973	261	26.8	300	78 300	15 977.115	0.0072	0.0015
Raphicerus campestris	Steenbok	10 822 000	3 391	622	18.3	300	18 600	3 795.33	0.0017	0.00035
Syncerus caffer	Buffalo	10 822 000	19 697	138	0.78	5 000	690 000	140 794.5	0.064	0.013
Papio ursinus	Baboon	10 822 000	3 037	265	8.7	200	53 000	10 814.65	0.0049	0.001
Total		10 822 000	**200 704**	**3807**	**1.90**		**7 266300**	**1 484 688.52**	**0.65**	**0.13**

Source: Own calculations based on Wildlife Hunting Quota for 2003

The total extraction rate for all species was 1.9%, while the total value (flow) of this extraction was estimated at P7 266 300 (US$1 482 688.52). On per hectare basis, this is translated into P0.69/ha (US$0.14/ha). The flow values may be considered true estimates of the extraction value because the values were derived from the actual number of animals allocated in hunting quotas.

Scenario 2: Direct use values of wild herbivores using non-citizen prices

In the second scenario, the total direct use value of extraction was estimated at P2 299 100 (US$469 131.4), and the direct use value per hectare was estimated at P0.21/ha (US$0.043/ha). The total direct use value, which represents a conservative estimate, is one third of the estimated value in the first scenario.

Table 10: **Estimates of direct use values using citizen prices**.

Species name	Common Name	Area (ha)	Total animals	Off-take of animal stock per annum	Rate of extraction per annum (%)	Price (Pula)	Total value (Pula)	Total value (US$)	Value/ha (P/ha)	(Value/ha) (US$/ha)
Loxodonta Africana	Elephant	10 822 000	57 381	156	0.27	8 000	1248 00	254 654.4	0.12	0.024
Equus burchelli	Zebra	10 822 000	17 447	106	0.61	1000	106 000	21 629.3	0.0098	0.0020
Phacochoerus aethiopicus	Warthog	10 822 000	1 148	245	21.3	150	36 750	7 498.84	0.0034	0.00070
Taurotragus oryx	Eland	10 822 000	360	29	8.1	700	20 300	4 142.22	0.0019	0.00038
Tragelaphus strepsiceros	Kudu	10 822 000	3 693	180	4.9	300	54 000	11 018.7	0.0050	0.0010
Tragelaphus spekei	Sitatunga	10 822 000	167	0	0	1500	0	0	0	0
Oryx gazelle	Gemsbok	10 822 000	7 191	38	0.53	700	26 600	5 427.73	0.0025	0.00050
Hippotrugus niger	Sable	10 822 000	949	0	0	1500	0	0	0	0
Kobus leche	Lechwe	10 822 000	48 628	296	0.61	300	88 800	18 119.64	0.0082	0.0017
Redunca arundinum	Reedbuck	10 822 000	67	0	0	500	0	0	0	0
Damaliscus lunatus	Tsessebe	10 822 000	4 560	398	8.7	500	199 000	40 605.95	0.018	0.0038
Alselaphus buselaphus	Hartebeest	10 822 000	414	40	9.7	300	12 000	2 448.6	0.0011	0.00023
Connochaetes taurinus	Wildebeest	10 822 000	5 765	132	2.3	500	66 000	13 467.3	0.0061	0.0012
Aepyceros melampus	Impala	10 822 000	26 419	860	3.3	150	129 000	26 322.45	0.012	0.0024
Antidorcas marsupialis	Springbok	10 822 000	1 417	41	2.9	100	4 100	836.61	0.00038	0.000077
Sylvicapra grimmia	Duiker	10 822 000	973	261	26.8	100	26 100	5 325.71	0.0024	0.00049
Raphicerus campestris	Steenbok	10 822 000	3 391	622	18.3	100	62 200	1 2691.91	0.0057	0.0012
Syncerus caffer	Buffalo	10 822 000	19 697	138	0.78	1500	207 000	42 238.35	0.019	0.0039
Papio ursinus	Baboon	10 822 000	3 037	265	8.7	50	13 250	2 703.66	0.0012	0.00025
Total		10 822 000	**200 704**	**3807**	**1.90**		**2 299 100**	**469 131.4**	**0.021**	**0.0043**

Source: Own calculations based on Wildlife Hunting Quota for 2003 and Single Game License Hunting Fees

5.3.2 Vegetation

Two scenarios were developed based on the estimated direct use values and the conservative estimates. In the first scenario, it was assumed that households sold all of their harvest in the market. This scenario represents the value of the total quantities of vegetation resources. In the second scenario households were assumed to sell part of their harvest because the market was not well developed. In addition, households used part of the resource collected at home. It was assumed that households sold only 30% of the harvest or collection while prices remained unchanged. The second scenario represents the value of what households actually use.

Scenario 1: Households sell all their harvest

The household survey in the villages of Shakawe, Etsha-13 and Shorobe revealed that households harvest a number of products of vegetation (Table 11).

Table 11: Percentage of households harvesting vegetation resources in the Okavango Delta

Resource	Village			
	Shakawe	Etsha-13	Shorobe	Average %
River reed	81	67	24	57
Thatching grass	81	49	16	49
Wild fruits	45	25	4	27
Fuelwood	92	98	87	92
Palm leaves	27	42	33	34
Medicinal plants	8	20	9	12

Source: Compiled from the household survey in 2003 conducted by the author, and household survey conducted by Applied Development Research Consultants in 2001

5.3.2.1 River reed

Two species of reeds, *Phragmites australis* and *Phragmites mauritianus,* are harvested in the area. *Phragmites mauritianus*, also known as the common reed, is more spiny, taller and more productive than *Phragmites australis.*

At Shakawe, river reed is harvested from August to December when the Okavango Delta flood levels have receded. Reeds are harvested using a sickle and then made into bundles. An average reed bundle measures approximately 800 mm in diameter and weighs 10 kg. Information from the household survey and discussion groups revealed that on average, 3 bundles are harvested by an individual in 8 hours per day. The average frequency of harvesting was about twice a week. Based on the frequency and the seasonality of harvesting, the annual labour hours of harvesting were calculated to be 336 hours. The total number of bundles harvested annually was therefore 126. Bundles are then carried by head to the household yard. A bundle of reed was worth P20.00 (US$4.08) in 2003.

At Etsha-13, the harvesting of river reed commences in December and ends in mid February when the flood levels have peaked. A reed harvester in Etsha-13 spends 8 hours a day to harvest 2 bundles. More time is spent walking an approximate distance of 5 kilometres to the harvesting site. On average, the frequency of harvesting was reported to be 2 times a week. The total labour hours for harvesting were therefore 171.2 hours. On this basis, fourty three (43) bundles were harvested annually from Etsha-13. All harvesters reported that they carry the reeds on their heads. As in Shakawe, a bundle of reed was worth P20.00 (US$4.08) in 2003.

At Shorobe, the harvesting of river reed starts in August and ends in January. The bundles of reeds are made smaller than those at Shakawe and Etsha-13, and measure about 400 mm in diameter. While harvesters at Shakawe are closer to the river, those in Shorobe are about 25 kilometres away from the harvesting site. Harvesters hired transport for transporting them to the harvesting site where they stay for about two and half months. At the site, an average harvester spends about 10 hours to harvest 10 bundles per day. The reported frequency of harvesting was 6 days a week. The total estimated labour hours are thus 516 hours and the total number of bundles harvested was 516 bundles. Each bundle was sold for P10.00 (US$2.04) in 2003.

Using reported prices of reeds from the household survey and group discussions, the total estimated annual use value of reed in the riparian communities was estimated at P25 588 400.00 (US$5 221 313.02) in 2003, while the value of river reed per hectare was estimated at P142.16 (US$29.00).

5.3.2.2 Thatching grass

At Shakawe, *Miscanthus junceus* is the main thatching grass. The harvesting season is from August to December. Eighty-one percent of the households at Shakawe were involved in the harvesting of *Miscanthus junceus*. Approximately 4 bundles of grass are harvested in 8 hours per day by one harvester twice a week. It has also been reported that it takes less time to harvest a bundle of grass than river reed. The total labour hours for

grass harvesting was 336 hours. Annually, a household therefore harvests about 168 bundles. A bundle of *Miscanthus junceus* measures about 850mm in diameters and weighs almost the same as a bundle of river reed. A bundle of grass was worth P20.00 (US$4.08) in 2003.

Miscanthus junceus is also the main thatching grass at Etsha-13. The harvesting period is from December to mid-February. It takes an average harvester 10 hours per day to harvest 3 bundles of grass per day. The harvesting site is approximately 7 kilometres away. The harvesting frequency was twice a week. The total labour hours for harvesting were estimated at 214 hours per year. Annually, a household therefore harvests 64 bundles of grass. Despite the fact that the village is located some kilometers away from the harvesting site, none of the households reported to be using any other means of transport other than carrying the bundles one by one on their heads. The local price of the grass was P20.00 (US$4.08) in 2003.

At Shorobe, the main thatching grass species is *Cymbopogon excavatus* which is harvested between July and October. Harvesters pay for transporting their bundles by sharing the total bundles equally between themselves and owner of transport. On average, 8 bundles are harvested in 10 hours per day. The average frequency of harvesting was six (6) days in a week. The total labour hours for harvesting was estimated at 642 hours. The annual number of bundles harvested was 514. A bundle for *Cymbopogon excavatus,* which has a diameter of 500mm, and an average weight of 4.5 kg, was worth P10.00 (US$2.04) in 2003. The annual direct use values of thatching grass in the riparian communities was estimated to be P706 208 (US$144 101.74) in 2003 (table 12) which translates to P3.92/ha (US$0.80/ha).

5.3.2.3 Palm leaves (Hyphaene petersiana)

The leaves of the palm tree (Hyphaene petersiana) and the roots and/or bark of bird plum (Berchemia discolor) and diamond leaved euclea (Euclea divinorum) are used in the making of baskets. The roots/and or bark of Berchemia discolor are used to produce red

dye, while Euclea divinorum is used to produce brownish dye. Hyphaene petersiana can be harvested year round. According to group discussions, the majority of basket makers harvest the palm tree leaves for own production of baskets. The average harvesting frequency was once a month. The harvested leaves are cooked and dried and tied into small bundles. From the initial harvest, about 5 small saleable bundles can be made. An average dry bundle weighs about 37 grams (0.037kg). Thus, the total amount of palm leaves harvested per household per year was 2.2kg. Each bundle was sold for P2.00 (US$0.41) in the local market during 2003. Thus, a kilogram of dry palm leaves would cost about P54.00 (US$11.02). The annual direct use values of harvesting palm leaves from all riparian communities in the area was estimated at P638 431.20 (US$130 271.89) (table 12) during 2003. This value translates to P1.53/ha (US$0.31/ha).

5.3.2.4 Wild fruits

Fifteen wild fruits were reportedly harvested by respondents in all the three villages. The reported harvested wild fruits were corky bark monkey orange *(Strychnos cocculoides),* spiny leaved monkey orange *(Strychnos pungens),* kalahari pobery *(Dialium engleranum),* false brandybush *(Grewia bicolor),* brandybush *(Grewia flava*), large sour plum *(Ximenia caffra),* rough-leaved raisin bush *(Grewia flavascens*), rough-leaved raisin bush *(Grewia retinervis*), makettii tree *(Recinidendron rautenenii*), African mongostein *(Garcinia livingstonei),* bird plum *(Berchemia discolor),* water lily *(Nymphaea caerula)* and African ebony *(Diospyros mespiliformis)*

In this study, the main wild fruits which are often sold in the market were *Strychnos cocculoides*, *Strychnos pungens*, *Grewia bicolor, Grewia flava, Garcinia livingstonei Berchemia discolor* and *Nymphaea caerula.* An average household harvests about 10 fruits of *Strychnos cocculoides*, 10 fruits of *Strychnos pungens*, twice a month during the harvesting period. A single fruit of each plant weighs about 200 grams and was sold for P1.00 (US$0.20) in 2003. For the water lily (*Nymphaea caerula)*, a household harvests about 2 kilograms at a frequency of four times during the harvesting season. A bulb of *Nymphaea caerula,* which weighs about 150 grams, was sold for P0.50 (US$0.10) during

2003. For *Grewia bicolor, Grewia flava, Garcinia livingstonie* and *Berchemia discolor*, the group discussions indicated that the harvesting frequency of an average household was about twice during the harvesting period. A harvester therefore harvests about 2 kilograms of each fruit. A cup full of each fruit was sold for about P1.00 in the local market in 2003.

Using 4 months as an average harvesting period and the different collection frequencies for different wild fruits, the total amount of fruits collected by an average household was estimated at 128 kg. When an average market price of P4.4/kg was used for all saleable fruits, the average annual household value for fruit collection was calculated to be P563.20 or US$114.92. Table 10 shows that the total estimated amount of fruit collected by riparian communities in the Okavango Delta was P2 225 766.40 (US$454 167.63) during 2003, which translates to P5.33/ha (US$1.09/ha).

5.3.2.5 Fuelwood

A large number of households depend on fuelwood as a source of energy. The most preferred tree species of fuelwood are *Diospyros mespiliformis*, *Terminalia sericea*, *Acacia erubescens*, *Combretum collinum*, *Acacia negrescens*, *Combretum imberbe*, *Baikiaea plurijuga*, *Dichrostachys cenerea*, *Guiboutia coleosperma*, *Colophospermum mopane*, *Acacia tortilis*, *Erythrophleum africanum*, *Euclea undulata*, *Ximenia caffra*, *Ziziphus mucronata*, *Pterocarpus angolensis*, *Lonchocarpus capassa*, *Garcinia livingstonei*, *Croton megalobotrys* and *Bocia albitrunca*. Only dead wood was reported to be collected in all the three villages. The majority of the households collected fuelwood in bundles which they carry on their heads. A few households use donkey carts to carry fuelwood. A bundle of fuelwood weighs about 12 kilograms, while a one-axle load on a donkey cart weighs about 350 kilograms. About 29 bundles of fuelwood can fill up a one-axle donkey cart (350 kg). Group discussions revealed that on average, a bundle of fuelwood can last 3 days. Thus, fuelwood requirements for a week were estimated at 28 kg. On an annual basis, a household fuelwood requirement would be 1 456 kg (1.456 tones). Based on the price of a one-axle donkey cart load of fuelwood of P45.00

(US$9.18) during 2003, the annual revenue for a household would be about P187.00 (US$38.16). The annual direct use value of fuelwood collection in 2003 is shown in Table 12. The total annual direct use value in the riparian communities was estimated at P2 752 509.70 (US$561 649.60) during 2003. On per hectare basis, this was P6.6/ha (US$1.35/ha).

The overall total direct use value of vegetation resources (river reed, thatching grass, fuel wood, wild fruits and palm leaves) was estimated at P29 908 315.74 (US$66 102 791.74) (Table 12), which translates to P159.53/ha (US$ 32.55/ha). The total direct use value is considered an underestimate because it includes only plant products that are marketed.

Table 12: **Estimated direct use value of vegetation in 2003**

Resource	Area (ha)	Average annual household harvest (kg)	Estimated number of Household harvesting	Estimated total harvest (kg)	Price (Pula/kg)	Value per household (Pula)	Total estimated value (Pula)	Total estimated value (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
River reed	180 000	1 420	9 010	12 794 200	2.00	2 840.00	25 588 400	5 221 313.02	142.16	29.0
Grass	180 000	116	3 044	353 104	2.00	232.00	706 208	144 101.74	3.92	0.80
Fuelwood	417 500	1 456	1 4542	21 173 152	0.13	189.28	2 752 509.70	561 649.60	6.60	1.35
Wild fruits	417 500	128	3 952	5 05 856	4.4	563.20	2 225 766.40	45 455.48	5.33	1.09
Palm leaves	417 500	2.2	5 374	11 822.8	54.00	118.8	638 431.20	130 271.89	1.53	0.31
Total			**35 922**	**34 838 134.8**		**3 583.28**	**29 908 315.74**	**6102 791.74**	**159.53**	**32.55**

Source: Compiled by author from the household survey in 2003

Table 13: **Conservative estimate of the value of vegetation in 2003**

Resource	Area (ha)	Average annual household harvest (kg)	Estimated number of Household harvesting	Estimated saleable harvest (kg)	Price (Pula/kg)	Total value (Pula)	Total value (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
River reed	180000[a]	1420	9010	3838260	2.00	7676520	1566394	42.6	8.7
Grass	180000	116	3044	105931.2	2.00	211862.4	43230.52	1.17	0.24
Fuelwood	417500[b]	1456	14542	6351945.6	0.13	825752.93	168494.90	1.98	0.40
Wild fruits	417500	128	3952	151756.8	4.4	667729.92	136250.3	1.60	0.33
Palm leaves	417500	2.2	5374	3546.84	54.00	191529.36	39081.57	0.46	0.094
Total			**35 922**	**10 451 440**		**9 573 24.61**	**1 953 396.08**	**48.81**	**9.76**

Source:Table12

Scenario 2

In the second scenario, the total estimated direct use value of river reed, thatching grass, fuel wood, wild fruits and palm leaves were P9 573 124 (US$1 953 396.07) and the per hectare value was estimated at P48.81/ha (Table 13). Values under this scenario can be considered to represent the real situation.

5.3.2.6 Traditional medicinal plants

Plants reported to be used as traditional medicines *were Diospyros lycioides, Bauhinia variagata, Terminalia serecea, Combretum collinumn, Recinidendron rautenenii, Acacia erioloba, Acacia tortilis, Adansonia digitata, combretum imberbe, Bocia albitrunca, Acacia galpinii, Rhus tenuinervis, Clerodendrum ternatum, Ximenia americana, Melhania griquensis, Enicostema ascillare, Combretum hereroense, Pterocarpus capasa, Ficus sycomorus, Gardenia spatulifolia, Croton megalobotrys, Albizia anthelmentica Colophospermum mopane, Ficus thonningii, Euclea divinorum and Harpagophytum procumbens*. Plant parts used for various ailments are shown in Table 14.

Table 14: **Plants parts used as traditional medicine**

Plant	Ailment	Part used
Dispyros lyciocoides	gonorrhea	roots
Terminale serecea	diarrhea, pneumonia, schistomiasis	roots, barks, leaves
Acacia eriolaba	ear infections, headache, stops bleeding	bark, roots leaves
Acacia tortilis	stops vomiting	leaves
Adansonia digitata	diarrhea, fever	leaves, bark
Combretum imberbe	cough	flowers
Bocia albitrunca	epilepsy	unripe fruit
Enicostema ascillare	general pain killer	leaves
Acacia nibrownii	tuberculosis	roots
Clerodendrum ternatum	wound healing	roots
Ximenia americana	pain killer	roots
Melhenia griquensis	improves blood circulation	roots
Combretum hereroense	general pain killer, stomach disorder	roots
Perocarpus capasa	stops bleeding common cold, snake bite	bark
Ficus sycomorus	chest ailments, sore throat	bark and latex
Gardenia spatulifonia	sore throat	roots
Croton megalobytrys	fever (malaria)	bark, seeds
Albiza anthelmentica	body sores	bark and roots
Colophospemum mopane	would healing	gum from wood
Ficus thonningii	snake bite, influenza, syphilis, diarrhea	bark roots
Eulea divinorum	relieves constipation	roots
Harpogiphytum procumbens	painful joints	tubers

Source: compiled by author from the household survey of 2003, Roodt (undated), Hedberg and Staugard (1989)

The valuation of traditional medicinal plants is beset with problems. First, it is very difficult to estimate the quantities or volumes of plants components (roots, bark, leaves or herbs) that are used as traditional medicine. Thus, respondents could not state how much roots or leaves they chewed or how many tea-spoons of powdered materials they used. Second, people use traditional medicine only when they fall sick. This creates the problem of estimating the quantities of medicines used during the year.

It is also difficult to establish the price of traditional medicine because some people harvest traditional medicines from the wild in order to treat themselves without having to buy the medicine elsewhere. Many people visit traditional doctors not to buy traditional medicine but to consult and get treatment. A minimal consultation fee ranging from P10-20 is paid. Thereafter, a larger fee, which includes the whole treatment service, is paid after the patient and the traditional doctor have agreed on the prescribed treatment and the cost thereof. The service may also include performance of rituals. The treatment usually involves more than one type of traditional medicine.

Second, asking people about traditional medicine is a sensitive issue, particularly when the medicine is used to treat sexually transmitted diseases (STD). Traditional medicine is also regarded as inferior to western medicine. These two aspects lead to a people's unwillingness to reveal all the information that is related to the use of traditional medicine.

Third, whether or not traditional medicine treats reported ailments is subject to scientific investigation or tests. Most traditional medicines have not been subjected to laboratory tests. Given this situation, it appears incorrect to use substitute prices of conventional medicines for the cases that traditional medicines were reported to cure. On the basis of these problems, the value of traditional medicine was not estimated.

5.3.3 Water supply and use

The main source of water for the Ngamiland district is the Okavango Delta which has its sources in Angola. Summer rainfall contributes significantly to the flow of the Okavango River which discharges into the Panhandle at Mohembo where the Okavango River enters Botswana. Annual input of rainfall in the Okavango Delta amounts to about 6 144 million cubic metres (Republic of Namibia, 1997), while annual evaporation is estimated at 2 172 mm (Gumbricht et al., 2004).

The Water Unit of the Ngamiland District Council is responsible for supplying water to the rural population in the two sub-districts of Ngami and the Okavango. In the Ngami sub-district where most villages are located far from the Okavango River channel, water is pumped from boreholes into storage tanks and then supplied via stand-pipes. In other smaller rural villages, water is supplied directly from the boreholes. In the Okavango sub-district, groundwater is supplied from boreholes while surface water is supplied from treatment plants to the neighbouring villages.

In the village of Maun, the Department of Water Affairs is responsible for the supply of water to the village. Groundwater is supplied from a wellfield which depends on recharge from seasonal swamps floods in the Shashe River. Water is consumed by the following sub-sectors: domestic (house, yard, stand pipes), institutional (boarding schools, hospitals, force, administration offices), commercial (shops, workshops, banks, restaurant, hotels, irrigation and others), industrial (abattoirs, brick moulding) agriculture (irrigation and livestock). Table 15 shows the quantities and values of water yielded by boreholes (groundwater) and treatment plants (surface water) during 2003.

The source of water for the village of Maun and Ngami sub-district is groundwater, while that for the Okavango sub-district is surface water. The water consumption charges are determined based on the quantities of water supplied to the consumer. Each unit charge corresponds to a water use band. The minimum tariff charge is P3.75/m^3. Using a water consumption tariff of P4.95/m^3, the value of groundwater for the village of Maun and the Ngami sub-district were estimated at P6 413 130.90 (US$1 308 599.36) and P2 477 054.25 (US$505 442.92), respectively, while the value of surface water for the Okavango sub district was estimated at P5 342 559.75 (US$1 090 149.32) (Table 15). The total value of water used during 2003 was estimated at P14 232 744.9 (US$2 904 191.60), and the total value per hectare was estimated at P130.58/ha (US$26.6/ha). This value does not include the value of water used by wildlife and tourist camps situated along the Okavango Delta, as no record of these is made.

Table 15: Estimates of direct use value of water in the Okavango Delta

Surface area (ha) 109 000	Village District	Groundwater water (m^3)	Surface water (m^3)	Total annual yield (m^3)	Water tariff (P/m^3)	Value of water (Pula)	Value of water (US$)	Value per hectare (Pula/ha)	Value per hectare (US$/ha)
	Maun	1 295 582	0	1 295 582	4.95	6 413 130.90	1 308 599.36	58.84	12
	Okavango Sub-district	586 555	492 750	1 079 305	4.95	5 342 559.75	1 090 149.32	49.01	10
	Ngami Sub district	500 415	0	500415	4.95	2 477 054.25	505 442.92	22.73	4.6
	Total	**283 647**	**492 750**	**2 876 397**	**4.953.45**	**14 232 744.9**	**2 904 191.60**	**130.58**	**26.6**

Sources: Own calculations based on report of Waste Water Department and Republic of Botswana (2003c).

Using the minimum water consumption tariff of P3.75/m^3, which can be considered a conservative estimate, the value of water was estimated at P10 782 382.5 (US$2 200 143.31). The total estimate of the direct value of water obtained using a tariff of P4.95/m^3 was about 1.3 times the value of water obtained under a minimum value of P3.73/m^3 as shown in Table 16.

Table 16: Direct use value of water using minimum tariff

Surface area (ha) 109 000	Area	groundwater water (m^3)	Surface water (m^3)	Total annual yield (m^3)	Water tariff (P/m^3)	Value of water (Pula)	Value of water (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
	Maun	1 295 582	0	1 295 582	3.75	4 858 432.5	991 361.32	44.57	9.09
	Okavango Sub-district	586 555	492 750	1 079 305	3.75	4 047 393.75	825 870.69	37.13	7.38
	Ngami Sub district	500 415	0	500 415	3.75	1 876 556.25	382 911.30	17.22	3.51
	Total	**283 647**	**492 750**	**2 876 397**	**3.75**	**1 078 2382.5**	**2 200 143.31**	**98.92**	**19.98**

Source: Table 15

5.4 Indirect use values

5.4.1 Honey production

Bee-keeping is an income generating activity for individual farmers or groups of farmers, communities or clubs. The production of honey depends on a number of environmental factors, such as rainfall that influence flowering in vegetation that is the source of nectar. Under optimal environmental conditions in Botswana, a hive produces about 12 kg of honey per harvest (Madisa personal communication, 2004). However, because of the variation in environmental conditions, production levels can be as low as 9-10 kg per hive. There were a total of 58 hives during 2003 and the total production was estimated at 1392 kg. At a market price of P30/kg of honey, the value of honey was estimated at P41 760.00 (US$8 531.13), which translates to P0.1/ha (US$0.02/ha) (Table 17).

Table 17: Honey production under optimal environmental conditions

Surface area	No. of hives	Average production per hive (kg)	Period of honey flow	Total honey production (kg)	Market price of honey (P/kg)	Value of honey (Pula)	Value of honey (USD)	Value per hectare (Pula/ha)	Value per hectare (US$/ha)
417500	58	12	2	1 392	30	41 760	8 521.13	0.1	0.02

Source: Own calculations based on Madisa and Keaja (2003), Madisa Personal communication (2004), Annual Beekeeping Report for Ngamiland (2003/2004)

At a production level of 9 kg per hive the total value of honey was estimated at P3 1320 (US$6 390.85) or P 0.075/kg (Table 18). The value of production under the first scenario was about 1.3 times that under this scenario.

Table 18: Honey production under sub-optimal environmental conditions

Surface area (ha)	No. of hives	Average production per hive (kg)	Period of honey flow	Total honey production (kg)	Market price of honey (P/kg)	Value of honey (Pula)	Value of honey (USD)	Value/ha (Pula/ha)	Value/ha (US$/ha)
417500	58	9	2	1 044	30	31 320	6 390.85	0.075	0.015

Source: Table 17

5.4.2 Carbon sequestration

In their study, Veenendaal et al. (2004) estimated the net uptake of carbon dioxide to be 1 mol Cm^{-2} yr^{-1} during a 12 months period. The annual net photosynthesis (gross primary production) was estimated to be 32.2 mol m^{-2} yr^{-1} which translates to 0.322 tonnes per hectare (*1 mole C = 1 gram C*). Since there are no markets for determination of the value of carbon in Botswana, this study used carbon value estimates from other studies. In South Africa, where carbon dioxide contributes 60% of the total greenhouse gas emissions Hassan (2002) estimated the value of carbon to be US$5.4/ton in 1995 prices. Applying carbon price of US$5.4/ton to Botswana, the total value of carbon sequestrated

by Mopane woodlands was estimated at P1 533 859.0 (US$312 984.00) or P1.74/ha (US$0.35/ha) (table 19).

Table 19: **The Value of carbon sequestration**

Surface area (ha)	Carbon sequestrated per tone	Carbon sequestrated per total area (tones)	Price of carbon (Pula/t)	Price of carbon (US$/t)	Value of carbon (Pula)	Value of carbon (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
180 000	0.322	57 960	24.5	5.4	1 533 859.3	312 984	1.74	0.35

Sources: Own calculations based on Hassan (2002), Veenendaal et al. (2004)

5.4.3 Livestock grazing

Information on the statistics of livestock does not show figures for livestock according to the types of breed of cattle. However, the Tswana breed (the local breed), is the most common in the country, and is expected to constitute the highest number of livestock. Two scenarios were formulated based on a number of assumptions and information from various sources. In the first scenario, it was assumed that:

(i) Ninety percent (90%) of the cattle LSU that grazed in the Okavango Delta during 2003 were of the pure Tswana breed as most local farmers prefer to keep the local breed because of its local adaptation for factors such as diseases, parasite and drought. Ten percent (10%) of the cattle LSU the cross breed between Tswana and Brahman because some of the farmers take advantage of genetic traits from different animal breeds.

(ii) Carl Bro (1982) cited in Duraiappah and Perkins (1999) found that in Botswana, livestock units (LSU) (450kg) values vary from 1.2 LSU for a bull to 0.1 LUS for a calf, with a cow or ox that is 4 years old and older being 1.0 LSU.

(iii) The pure Tswana breed LSU grows at a rate of 0.4kg per day or 146 kg per year, while the cross breed between Tswana and Brahman LSU grows at a rate of 0.5kg per day or 183 kg per year (Raditedu Personal Communication, 2004).

(iv) Fifty five percent (55%) of the grazing intake is converted into animal biomass (King, 1983).

(v) The 'All Animal Grade' price of P272 per 1000kg (P0.272/kg) for Botswana Meat Commission (BMC) was used to determine the value of grazing for both pure Tswana breed cattle and the composite breed (Tswana x Brahman)

In the second scenario, it was assumed that one hundred percent (100%) of the cattle LSU that grazed in the Okavango Delta during 2003 were of pure Tswana breed. The growth rate of the LSU units, the feed conversion rate and the grade price for BMC were as stated in the first scenario.

Scenario 1: Grazing values for a cross breed

Using information on the livestock statistics and the livestock unit equivalents, there were a total of 75 096 LSU. Ninety percent (67 586) of these were Tswana breed LSU, while the remaining 10% or 7510 were a cross breed of Brahman and Tswana LSU. Taking 55% to be protein conversion efficiency, the total grazing uptake (kg/LSU) for Tswana breed LSU was therefore 146kg x 100/55 =265 kg, while that for the cross breed was 183 kg x 100/55 = 333kg. The value of grazing was estimated from LSU biomass production (kg) x total number of LSU x the price of beef (P/kg). Using the price of P0.272/kg, the total grazing value was estimated at P3 057 792. 99 (US$623 942.660), while the value of grazing per hectare was estimated at P7.33/ha (US$1.54) (Table 20).

Table 20: **The value of grazing for a Tswana breed and a cross breed between Tswana and Brahman cattle**

Surface area (ha)	Total no. of LSU	LSU biomass production per year (Kg)	(% contribute -on to LSU biomass productio n	Grazing uptake (kg/LSU)	Total equivalent biomass production (kg)	Price of beef (Pula/kg)	Value of grazing (Pula)	Value of grazing (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
417 500 417 500	67 586 7 510	146 183	55 55	265 333	9 867 556 1 374 330	0.272 0.272	2 683 975.23 373 817.76	547 665.15 76 277.51	6.43 0.90	1.31 0.23
Total	75 096	329	55	698	11 241 886	0.272	3 057 792.99	623 942.66	7.33	1.54

Source: Own calculations based on Raditedu personal communication (2004), Botswana Meat Commission (2003), Animal Stock Census for Ngamiland in 2003, King (1983), Bendsen (2002)

Scenario 2: Grazing value for a Tswana breed

A lower estimate of the value of grazing was that of the Tswana cattle, which was P 2 982 212.35 (US$ 608 520.43). The value of grazing per hectare was calculated to be P7.14/ha (US$1.46/ha (Table 21). The value of grazing for a cross breed was about 1.3 times the value of grazing for a pure breed of Tswana cattle.

Table 21: Estimated grazing value for pure Tswana cattle breed.

Surface area	Total no. of LSU	LSU biomass productio n- per year (Kg)	(% contributi on to LSU biomass productio n	Grazing uptake (kg/LSU)	Total equivalent biomass production (kg)	Price of beef (P/kg)	Value of grazing (Pula)	Value of grazing (US$)	Value/ha (Pula/ha)	Value/ha (US$)
417 500	75 096	146	55	265	10 964 016	0.272	2 982 212.35	608 520.43	7.14	1.46

Sources: Own calculations based on Raditedu, personal communication (2004), Botswana Meat Commission (2003), Animal Stock Census for Ngamiland in 2003, King (1983), Bendsen (2002)

5.4.4 Milk production

The value of milk produced can be estimated as the product of the number of births (a proxy for lactating cows), the average production of milk per cow and the price of milk per kg. Data for livestock population and the number of births for 2003 was not available. Therefore, the number of births for 2003 was estimated by projecting births for 2002 using a national average birth rate increase of 3% which was computed for 12 years (1979-1993). Using 3% as the average birth rate increase, the number of births or lactating cows was estimated at 34 138.

As with the value of livestock grazing, the production of milk is a function of breed of cattle. A pure dairy breed such as the jersey, produces more milk per cow than a non-dairy breed of cattle such as Tswana. The average annual milk production of a pure Tswana cow breed, a pure dairy breed cow and a cross breed between Tswana x Jersey is 300 kg, 2000 kg and 800 kg, respectively (Mahabile personal communication, 2004). Since statistics on livestock do not categorize animals according to the type of breed, the valuation of milk production was based on two scenarios and assumptions.

In the first scenario, it was assumed that 50% of the lactating cows were of Tswana breed, while the other 50 percent were of a pure dairy breed. In the analysis, the average annual milk production of 800kg for a cross breed was used. In the second scenario, it was assumed that all the lactating cows were of the Tswana breed.

Scenario 1: Value of milk production for a mixed breed

The total annual milk produced was estimated at P18 770 400 (18 770.4 tones). When valued at P1.70/kg, the total value was P31 909 680 (US$6 512 190.45). On per hectare basis this translates into P76.39/ha (US$17.62/ha) (Table 22).

Table 22: Milk production for Tswana breed and Jersey breed during 2003

Surface area (ha)	No. of lactating cows	Average production per cow (kg)	Total milk produced (kg)	Price of milk (P/kg)	Value of milk (Pula)	Value of milk (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
417500	17 064	300	51 192 00	1.70	8 702 640	1 776 793.94	20.84	4.25
417500	17 064	800	13 651 200	1.70	23 207 040	4 735 396.51	55.59	13.37
Total	34 128	1100	18 770 400		31 909 680	6 512 190.45	76.39	17.62

Sources: Own calculations based on Central Statistics Office (2002), Mahabile, personal communication (2004)

Scenario 2: Value of milk production for a Tswana breed

All animals under this scenario were of the Tswana breed which had an average annual milk production of 300 kg. Using the market price of milk of P1.70/kg, the annual value of milk production was estimated at P17 405 280 (US$3 551 547.38) (Table 23). Taking the size of communal area of 417500 hectares, the value of milk per hectare was estimated at P41.69/ha (US$8.5/ha) (Table 23).

Table 23: **Milk production for a pure Tswana cattle breed during 2003**

Surface area (ha)	No. of lactating cows	Average production per cow (kg)	Total milk produced (kg)	Price of milk (P/kg)	Value of milk (Pula)	Value of milk (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)
417500	34 128	300	10 238 400	1.70	17 405 280	3 551 547.38	41.69	8.5

Source: Own calculations based on Central Statistics Office (2002), Mahabile, personal communication (2004)

5.5 Non-consumptive use values

A total of 37 378 tourists visited the Moremi Game Reserve during 2003. Twenty-nine percent (29%) of the visitors were private visitors, 23% were clients from mobile operators, 23% were clients from fixed camps/lodges inside Moremi game reserve, and 25% were visitors from fixed camps/lodges outside Moremi Game Reserve. The

category of visitors were citizens (4 282), residents (2 435), South Africans (6 114), other African countries (615), North Americans (6 059), South Americans (532), United Kingdom (3 148), Europeans (12 529), Australians/New Zealand (1 300), Asia (281) and (other countries (81). Residents are not citizens of Botswana but stay in the country for various reasons such as diplomatic assignments. Europeans constituted the highest percentage of visitors (33.5 %), while tourists from South Africa constituted the second highest percentage (16%). The smallest percentage was constituted by visitors from other countries.

Two scenarios were developed using various assumptions and information from guidelines set by the Department of Wildlife and National Parks. In the first scenario it was assumed that:

(i) 2% of the citizen and resident visitors (134) had Maun and the surrounding areas as their origin. The remaining (6 583) traveled from the urban towns and villages to Maun covering an average return trip of 1396 km by road. No visitor used public transport. The number of vehicles was derived from: No of visitors/Average sitting capacity of each vehicle which was 5 people. Visitors covered a distance of 20 km of tarred road (Maun to Shorobe), and 80 kilometres of sandy road (Shorobe to Moremi game reserve). Thus, for a return trip, they also covered a distance of 40 km of tarred road and 160 kilometres of sandy road. The total cost of road travel was calculated from: Number of vehicles x Distance covered by each vehicle x Cost per kilometre.

(ii) Ninety-five percent (95%) of South African tourist visitors (5 808) used road transport from South Africa to Maun and passed through the boarder gates of Tlokweng, Martin Drift and Lobatse. No tourists used public transport. The expenditure on road transport was determined as in the first assumption.

(iii) Five percent (306) South Africans used air transport from South Africa to Maun. The cost of air travel was estimated from: the cost of a return ticket x the number of tourists

(iv) All international tourist visitors, comprising visitors from the U.K, Europe, North America, South America, other African countries, Asia and other countries, used air transport from either Johannesburg (South Africa), Victoria Falls (Zimbabwe) or Windhoek (Namibia). The expenditure on air travel was estimated as in the third assumption.

(v) The cost of accommodation (camping) was calculated from: Total number of people who spent nights in the park x Number of nights spent x Average camping fees per person per night. The camping fees are P5.00, P15.00 and P20.00 for citizens, residents and non-resident, respectively. Entry fees are P10.00, P20.00 and P30.00 for citizens, residents and non-resident, respectively. Other costs of tourists include vehicle, boat, aircraft and Parks and Reserve Reservation Office (PARRO).

(vi) Vehicle fees are determined based on weight of a vehicle and whether the vehicle is registered in Botswana or not. The revenue from vehicles was obtained from: Number of vehicles x Number of vehicle per day x Charge according to vehicle weight. Vehicles registered in Botswana weighing under 3 500 kg, between 3 500 and 7 000kg and over 7 000kg, are charged P10.00, P500.00 and P800.00, respectively. Vehicles that are not registered in Botswana weighing under 3 500 kg, between 3 500 and 7 000kg and over 7 000kg, are charged P50.00, P1 000.00 and P1 500.00, respectively.

In the second scenario, it was assumed that none of the citizen residents had Maun and the surrounding areas as their origin because the people from Maun and the surrounding areas are accustomed to seeing animals in their area, particularly in the local game reserve (Maun game reserve). It was also assumed that all South African visitors drove from South Africa to Botswana because they wanted to have a full experience of other places as they were driving to the Okavango Delta. The rest of the information and assumptions were as stated in the first scenario.

Scenario 1: Value (cost) of road travel by citizen in Maun and surrounding areas

The total average distance driven by citizen tourist visitors from urban towns and villages to Maun was estimated to be 698 km or 1 396 km per return trip. These visitors also drove a distance of 40 kilometres using tarred road and 160 kilometres using sandy road between Maun and Moremi game reserve. South African tourist visitors drove a distance of 925 km or 1 850 km for a return trip. As with citizen tourists, the South African tourist visitors drove a distance of 40 kilometres using tarred road and 160 kilometres using sandy road between Maun and Moremi game reserve. Using the calculated number of vehicles and the respective cost per kilometre, the total road travel costs were estimated at P13 932 (US$2 842.83) for visitors from Maun and the surrounding areas, P3 069 663.6 (US$626 364.86 for citizens not coming from Maun, P28 625 678 (US$5 841 669.1) for South African tourists and P3 164 628 (US$645 736.34) for international tourist. The total expenditure on travel was estimated at P9 673 903.6 (US$1 973 960.03) (Table 24).

Table 24: Road travel cost of tourists

Type of tourists	Number of tourists	Number of Vehicles	Distance traveled (km)	Rate used (Pula/km)	Cost of travel (Pula)	Cost of travel (US$)
Local (Maun)	134 134	27 27	40 160	1.3 2.90	1 404 12 528	286.49 2 556.34
Residents & other local tourists	6 583 6 583	1 317 1 317	1 436 160	1.3 2.90	2 458 575.6 611 088	501 672.35 124 692.51
South Africans	5 808 5 808 306 306	1 162 1 162 61 61	1 890 160 40 160	1.3 2.9 1.3 2.9	2 855 034 539 168 3 172 28 304	5 82569.69 110 617.23 647.25 5 775.43
International Overseas	30 664 30 664	6 133 6 133	40 160	1.3 2.9	318 916 2 845 712	65 074.81 580 667.53
Total	-	-	-	-	**9 673 903.6**	**1 973 960.03**

Source: Own calculations based on Northern Parks and Reserves Visitor Statistics Annual Report, 2003

Using P2 211.00 as the price of a return air ticket on Air Botswana travel schedule, and the number of tourists, the air travel expenditure for South African tourists was estimated at P676 566.00 (US$138 053.29) (Table 25).

Using the average price of an air ticket between Maun and Windhoek, Maun and Victoria Falls, and Maun and Johannesburg of P2 115.00, and the total number of tourists (30 664), the total expenditure on air travel for international tourists was estimated to be P64 854 360.00 (US$13 233 532.16). The total air travel for South African tourist and international tourists was therefore estimated at P65 530 926 (US$13 371 585.45) (Table 25).

Table 25: **Air travel costs of tourists**

Type of tourist	Number of tourists	Cost of return air ticket (Pula)	Travel cost (Pula)	Travel cost (US$)
South Africa	306	2211	676 566	138 053.29
International	30 664	2115	64 854 360	13 233 532.16
Total	**30 970**		**65 530 926**	**13 371 585.45**

Source: compiled from Northern Parks and Reserves Visitor Statistics Annual Report (2003)

The revenue generated from accommodation was P539 774.50 (US$110 140.99). Revenue generated from entry, vehicle, boat and aircraft fees are shown in Table 26. The highest of these revenues (78.26%) was constituted by entry fees.

Table 26: **Revenue by type of fees**

Type of fee	Revenue generated (Pula)	Revenue generated (US$)	% contribution
Entry	5 495 723.50	1 121 402.38	78.26
Camping	539 774.50	110 140.99	7.69
Vehicle	488 110	99 598.85	6.95
Boat	240	48.97	0.0034
Aircraft	34 050	6 947.90	0.48
PARRO	464 730	94 828.16	7.62
Total	**7 022 628.00**	**1 432 967**	**100**

Source: Northern Parks and Reserves Visitor Statistics Annual Report 2003

Scenario 2: No tourists from Maun and surrounding area, all South African tourists drive

The assumptions made under this scenario implied that resident visitors, citizen visitors and South African visitors would use more vehicles. Expenditure on road travel will increase as more vehicles would be used. The total expenditure under this scenario was estimated at P9 930 871.4 (US$2 026 394.31) (Table 27).

Table 27: Road travel cost of tourists under scenario 2

Type of tourists	Number of tourists	Number of Vehicles	Distance traveled (km)	Rate used (Pula/km)	Cost of travel (Pula)	Cost of travel (US$)
Residents & other local tourists	6 717 6 717	1 343 1 343	1 436 160	1.3 2.90	2 507 112.4 623 152	511 576.29 127 154.17
South Africans	6 114 6 114	1 223 1 223	1 930 160	1.3 2.9	3 068 507 567 472	626 128.85 115 792.66
International Overseas	30 664 30 664	6 133 6 133	40 160	1.3 2.9	318 916 2 845 712	65 074.81 580 661.53
Total					**9 930 871.4**	**2 026 394.31**

Source: Own calculations based on Northern Parks and Reserves Visitor Statistics Annual Report, 2003 and assumptions

Clearly, travel expenditure formed a significant part of the value of tourism (91.5%) as compared to accommodation (0.6%) and other costs (7.9%) in the first scenario (Table 28). However, in the second scenario, the road travel cost accounted for only 12%, while air travel constituted the largest percentage cost of 79%.

Table 28: **Overall direct non-consumptive use value for tourism in 2003**

Area (ha)	Number of tourists	Accommodation (Pula)[a]	Cost of road travel (Pula)	Cost of air travel (Pula)	Other costs[a]	Total value of tourism (Pula)	Expenditure per person	Value/ha (Pula/ha)	Value/ha US$/ha
Scenario 1									
491 400	37 378	539 774.50	9 673 903.6	6 553 0926	6 482 853.50	82 227 457.6	2 199.89	167.33	34.14
Scenario 2									
491 400	37378	539 774.50	9 930 871.4	6 553 0926	6 482 853.50	82 484 425.4	2 206.76	167.86	34.33

Source: Own calculations based on Northern Parks and Reserves Visitor Statistics Annual Report (2003)

The total value of tourism may be considered an underestimation because the air travel outside Botswana for some of the international tourist was not included in the analysis.

5.6 Non-use values

Estimates of total non-use values for households and tourists were derived by adding all the stated figures for willingness to pay for the preservation of the Okavango Delta. The figures were then converted to Pula or US$ using the prevailing exchange rate. The willingness to pay per person was estimated from: Total willingness to pay for all the respondents/Number of respondents with a positive willingness to pay.

5.6.1 Households' willingness to pay

In the first scenario households were assumed to be aware of the possibility of upstream abstraction of water, which might impact negatively on the benefits that households derived from the Okavango Delta. Consequently, it was assumed that the willingness to pay for the preservation of the Okavango Delta would be a maximum value that household would have decided to contribute. In the second scenario, it was assumed that there was no possibility of water abstraction and households would be willing to pay only a minimum. The minimum value would be equivalent to 1/3 of the maximum that households were willing to pay in the first scenario.

Scenario 1

The household survey revealed that 70% of the households were willing to pay for the preservation of the Okavango Delta. The rest of the households (30%) offered zero bids because they indicated that they did not have any contributions to offer. Respondents could be offering zero values because they believed that others will pay for action to take place. When excluding zero bids, the total willingness to pay for the preservation of the Okavango Delta was estimated to be P8 634.80 (US$1 761.93). The average willingness to pay was therefore P48.24 (US$9.84).

The total population of the head of households staying around and depending on the Okavango Delta was estimated at 15 806 (Population and Housing Census, 2001).

Extrapolating the sample survey results to the total population, the total number of households willing to pay was estimated at 11064, and the total willingness to pay was P533 727.6 (US$108 907.07) (Table 29). The willingness to pay per hectare was therefore P2.97/ha (US$0.6/ha).

Table 29: Maximum households' willingness to pay for the preservation of the Okavango Delta

Area (ha)	Number of household WTP	WTP per person (Pula)	WTP per person (US$	Total WTP (Pula)	Total WTP (US$)	WTP per hectare Pula/ha	WTP per hectare US$/ha
180 000	1 1064	P48.24	9.84	P533 727.60	108 907.07	2.97	0.6

Source: Own calculations based on household survey conducted by author in 2003

Scenario 2

Without the possibility of water abstraction, the total households' willingness to pay for the preservation of the Okavango Delta was estimated at P177 909.12 (US$36 302.36) which translates to P0.99/ha (Table 30).

Table 30: Minimum households' willingness to pay for the preservation of the Okavango Delta

Area (ha)	Number of household WTP	WTP per person (Pula)	WTP per person (US$	Total WTP (Pula)	Total WTP (US$)	WTP per hectare Pula/ha	WTP per hectare US$/ha
180 000	1 1064	P16.08	9.84	177 909.12	36 302.36	0.99	0.20

Source: Table 29

5.6.2 Tourists' willingness to pay

Two scenarios were formulated under the willingness of tourists to pay for the preservation of the Okavango Delta. In the first scenario it was assumed that because tourists have had an experience of the Okavango Delta, they held bequest and existence values, and were willing to pay for the preservation of the Okavango Delta to prevent any water abstraction from upstream of the Okavango Delta. In the second scenario it was assumed that there was no possibility of water abstraction and tourists would be willing to pay a minimum amount for the preservation of the Okavango Delta. The minimum amount was assumed to be 50% of that which they were willing to pay under the possibility of water abstraction in the first scenario.

Scenario 1

In the tourist sample survey, 33.3% of the respondents were willing to pay for the preservation of the Okavango Delta. 51.5% were not willing to pay, while 15.2% protested. Respondents who were not willing to pay were identified by having indicated a 'no' response to the willingness to pay question and then indicating their reason(s) for not willing to pay. Those protesting were identified by not responding to the willingness question, as well as not giving the reasons for not willing to pay. When considering only those who were willing to pay and contributing a value greater than zero, the total willingness to pay was estimated at P46 163.34 (US$9 419.63). The willingness to pay per person was estimated at P1 049.17 (US$214.08) (Table 31). The reasons given by those not willing to pay were responses such as: "I am already contributing to other conservation organizations"; "The Okavango Delta should not be disturbed so that there should be no need to finance its conservation"; "I have insufficient funds to contribute to the conservation of the Okavango Delta"; "The Okavango Delta should generate its own funds through tourism for its conservation"; "Even if I can contribute towards the conservation of the Okavango Delta, it is unlikely that my contribution will be channeled

to the conservation of the Okavango Delta"; "The conservation of the Okavango Delta should be the responsibility of Botswana government"; "The conservation of the Okavango Delta should be the responsibility of international conservation organizations"; "There are more international pressing issues than the conservation of the Okavango Delta."

Considering that the total number of tourists who visited Moremi Game Reserve during 2003 was 37 378 (Northern Parks and Game Reserve Statistics, 2003), it can then be inferred from the survey that 12 335 (33% *37 378) of the tourists were willing to pay for the preservation of the Okavango Delta. The total willingness to pay was estimated to be P99 236.00 (US$202 261.71). On per hectare basis this value converts to P5.5 (US$1.12/ha).

Table 31: **Maximum tourists' willingness to pay for the preservation of the Okavango Delta**

Area (ha)	Total number of individuals	Number of individuals WTP	Total WTP (Pula)	Total WTP (US$)	WTP per person (Pula)	WTP per person (US$)	WTP/ha (Pula/ha)	WTP/ha (US$/ha)
180 000	37 378	12 335	12 941 511.95	2 640 676.8	1 049.17	214.08	71.90	14.67

Source: Own calculations based on tourist survey conducted by author in 2003

Scenario 2

The minimum amount that tourists would be willing to pay under no possibility of water abstraction was estimated to be P6 470 755.98 (US$1 320 357.76), while the willingness to pay per hectare was estimates at P35.95/ha (Table 32).

Table 32:Minimum tourists' willingness to pay for the preservation of the Okavango Delta

Area (ha)	Total number of individuals	Number of individuals WTP	Total WTP (Pula)	Total WTP (US$)	WTP per person (Pula)	WTP per person (US$)	WTP/ha (Pula/ha)	WTP/ha (USD/ha)
180000	37 378	12 335	6 470 755.98	1320 357.76	173.12	35.33	35.95	7.34

Source: Table 31

5.7 Chapter conclusion

An effort has been made in this chapter to estimate the economic value of Okavango Delta for selected resources during 2003 using a total economic value framework (Table 33). The various components of total economic value were: composition of herbivores, direct consumptive use of herbivores, vegetation, water supply, direct non-consumptive use of tourism, indirect consumptive use of milk production, livestock grazing, carbon sequestration, honey production and existence value of the Okavango Delta.

The value of composition of wild herbivores was estimated at US$294 850 699.20 under a scenario where hunting license fees paid by non-citizens were used. In the second scenario, a conservative estimate value of composition was derived using hunting license fees paid by citizens. Similarly, the direct use value of wild herbivores of US$1 462 688.22 was derived using hunting license fees paid by non-citizens, while conservative estimates of wild herbivores were derived using hunting license fees paid by citizens. Conservative estimates of both compositional value and direct consumptive use value were underestimated values because they consider values derived using citizen prices which are lower than market prices of wild herbivores. Non- citizen prices, on the other hand are closer to the market values of wild herbivores.

The value of vegetation was estimated at US$6102791.74 under a scenario that assumed that all the harvested vegetation resources were marketed. Conservative estimates of

US$1 953 396.08 were derived under the second scenario that assumed that only 30% of the harvested plants were marketed. The second scenario represents a common situation because households are either not able to sell all their harvest due to lack of market or they are unable to use the plant material due to household labour constraints. Both of these factors lead to non-use of the resource and ultimately loss due to rotting during storage.

The value of water was estimated at US$2 904 191.60 using an average water consumption tariff. A conservative estimate of US$2 200 143.31 was derived based on the scenario that a minimum tariff was used. The minimum tariff leads to an underestimate.

The direct non-consumptive use of tourism was estimated at US$16 778 512.72 under the scenario that assumed that 2% of the local tourists had Maun and the surrounding areas as their origin. The second scenario, which assumed that there were no tourists visitors coming from Maun and the surrounding areas, led to an US$16 830 947. In this case value of the first scenario were conservative estimates

The value of livestock grazing was estimated at US$623 942.66 under the scenario that there were only Tswana and Brahman breeds, while a conservative estimate of US$608 520.43 was derived using the scenario that assumed that the Tswana breed of cattle were the only breed in the Okavango Delta. The value in the second scenario is a conservative estimate as it excludes the value of imported breeds of certain desirable characteristics.

The value of milk production was estimated at US$6 512 190.45 under the scenario that cattle breeds used in the production of milk were Tswana and Jersey. A conservative estimate of milk production of US$3 551 547.38 was derived under the scenario that assumed that only pure Tswana breed of cattle was used for milk production. The second scenario yields conservative estimates because it excludes the value of milk production from other breeds. However, Tswana breeds constitute the highest number of breeds in the country.

The existence value of the Okavango Delta was estimated by households to be $108 907.07 and tourists to be $2 640 676 under the scenario that there was a possibility of water abstraction by the Namibian Government. Conservative estimates were derived based on the scenario that there was no water abstraction. Estimates by households were $36302.36 while those of tourists were $1 320 357.76.

Table 33: **Summary of various economic values of the Okavango Delta**

COMPOSITION									
	Area	Estimated value (Pula)	Estimates value (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha)	Conservative estimate (Pula)	Conservative estimate (US$)	Value/ha (Pula/ha)	Value/ha (US$/ha
Herbivores	10 822 000	1 444 992 400	294 850 699.22	133.52	27.24	535881700	109 000 000	49.5	10.10
Total value		**1 444 992 400**	**294 850 699.2**	**133.52**	**27.4**	**535 881 700**	**109 000 000**	**49.5**	**10.10**
FUNCTION									
Direct consumptive									
Herbivores	10 822 000	7 266 300	1 482 688.52	0.65	0.13	2 299 100	469 131.4	0.021	0.0043
River reed	180 000	25 588 400	5 221 313.02	142.16	29	7 676 520	1 566 394	42.6	8.7
Thatching grass	180 000	706 208	144 101.74	3.92	0.80	211 862.4	43 230.52	1.17	0.24
Wild fruits	417 500	2 225 766.40	45 455.48	5.33	1.09	667 729.92	13 6250.3	1.6	0.33
Fuelwood	417 500	2 752 509.70	561 649.60	6.6	1.35	825 752.93	168 494.90	1.98	0.4
Palm leaves	417 500	638 431.20	130 271.89	1.53	0.31	191 529.36	39 081.57	0.46	0.094
Water	109 000	14 232 744.9	2 904 191.60	130.58	26.6	10 782 382.5	2 200 143.31	98.92	19.98
Total direct consumpt.		**53 410 360.2**	**10 489 671.85**	**291.46**	**59.28**	**22 654 877.11**	**4 422 726**	**146.75**	**27.75**
Indirect consumptive									
Honey	417 500	41 760	8 521.13	0.1	0.02	31 320	6 390.85	0.075	0.015
Carbon sequestration	417 500	1 533 859.30	312 984	1.74	0.35	-	-	-	-
Livestock grazing	417 500	3 057 792. 99	623 942. 660	7.33	1.54	2 982 212.35	608 520. 430	7.14	1.46
Milk production	417 500	31 909 680	6 512 190.45	76.39	17.62	17 405 280	3 551 547.38	41.69	8.5
Total indirect use value		**36 543 092.29**	**7 457 638.24**	**85.56**	**19.43**	**20 418 812.35**	**970 458.66**	**53.91**	**9.96**
Non -consumptive use									
Tourism	491 400	82 484 425.4	16 83 0 947.0	167.86	34.33	82 227 457.6	16 778 512.72	167.33	34.14
Total non-consumptive	**491 400**	**82 484 425.4**	**16 830 947.0**	**167.86**	**34.33**	**82 227 457.6**	**16 778 512.72**	**167.33**	**34.14**
Existence & bequest									
Household Tourists	491400 491 400	533 727.60 12 941 511..95	108 907.07 2 640 676.8	2.97 71.90	0.6 16.67	177 909.12 6 470 755.98	36 302.36 1 320 357.76	0.99 35.95	0.20 7.34
Total existence & bequest	491 400	**13 475 239.55**	**2 749 583.87**	**74.87**	**17.27**	**6 648 665.10**	**1 356 660.12**	**36.95**	**7.54**
Function: Grand total		**185 913 117.4**	**37 527 840.96**	**619.77**	**130.31**	**131 949 812.20**	**23 528 357.50**	**404.94**	**79.39**