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Quantifying the Potential of Restored Natural Capital to Alleviate Poverty and Help Conserve Nature: A Case Study from South Africa

James Blignaut and Christina Moolman
University of Pretoria
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Department of Economics
University of Pretoria
0002, Pretoria
South Africa
Tel: +27 12 420 2413
Fax: +27 12 362 5207
http://www.up.ac.za/up/web/en/academic/economics/index.html

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Biological diversity is an intrinsic feature of natural ecosystems supplying people with an array of environmental goods and services upon which society depends (Millennium Assessment 2003, Diaz and Cabido 2001, Engelhardt and Ritchie 2001, Ghilarov 2000). These goods and services include the provision of food resources, water purification and cycling, nutrient cycling, the regulation of atmospheric composition and the development and protection of soils (Nunes *et al*. 2003 and Cervigni 2001). Negative impacts on biodiversity are therefore likely to have negative consequences for ecosystem processes and functions.

In South Africa much of the current environmentally degraded land used to be *homelands*, i.e. the reserves for Black African people under the former Apartheid regime (Hoffman and Todd 1999, and DEAT 1997). The degradation resulted since people were forced to live on marginal land with little or no infrastructure and/or means for economic survival. This caused overgrazing and high levels of biomass harvesting for energy and construction purposes (Hassan 2002). Notwithstanding the fact that a stable democracy has replaced the Apartheid regime, by far the majority of people who live on these degraded areas are still poor (earning less than $1 a day) (SARPN 2003).

The question addressed in this chapter is whether a community conservation initiative (coupled with the restoration of degraded land) can be considered a feasible alternative land use option compared to subsistence agriculture. This question has discussed elsewhere (Barnes *et al*. 2003 and Luckert and Campbell 2003), but here we will tackle it by presenting alternative economic scenarios for an impoverished rural community living outside a national park in South Africa.

Background

One area where a community conservation initiative would make sense is in a portion of the Bushbuckridge district in the Limpopo Province, South Africa. The area under consideration ($31^{o}00'$ to $31^{o}35'$E; $24^{o}30'$ to $25^{o}00'$S) comprises 234,761 hectares of which 184,301 hectares are communal land not subject to any form of cultivation or habitation, but to which some 500,000 community members have open access for resource harvesting. Of this area, 43% is currently heavily degraded (CSIR 1996). In 2000 the Gross Geographic Product per capita, or, alternatively, the average income earned per person in the district was estimated at R3,400 (= $485) per annum with an unemployment rate of 65 per cent with formal employment declining by 1.2% annually over the period 1995 – 2000 (Limpopo Government 2002). Thus poverty is entrenched in the area and alternatives to alleviate poverty need to be considered.

One of the most noteworthy features of this area is that it borders the Kruger National Park (hereafter referred to as “Park”), a world-renowned conservation region. The adjacent communal area enjoys the same climate and in the past would have had the same vegetation and animal life as the Rooibos Bushveld zone of the Park. Currently, however, the Park area is still intact, and delivers a wide range of ecosystem goods and services, while the communal area is becoming increasingly degraded. This ecological dichotomy reflects different land use practices, and leads to an increase in economic and political tension. Neither the poverty nor the tensions will disappear unless a concerted effort is made to rehabilitate the land and restore the indigenous vegetation. The current land use practice is the result of lack of choice due to the current lack of alternative means of livelihood and of infrastructure and economic activity for local people. We assume that a land use change is possible, that game could replace current livestock and that the area could be managed as a private protected area.

Answering the question of whether community conservation in the BBR area poses a viable alternative land use option to the current subsistence land use implies comparing the total economic value of ecosystem goods and services provided by the Rooibos Bushveld area in the Park with the value of products extracted from the adjacent communal area.

We compare both the value of composition and the value of the biodiversity function activities of the Park area with that of the actual return from the current land use in BBR. Using this information a potential communal conservation-based capital stock value and flow of income stream will be calculated. This potential value is based on the premise that one could change the land use practice of communal from subsistence agriculture to community (private) conservation, but allowing sustainable resource harvest from the area. Such a community resource-harvesting regime in a protected area is not uncommon and the area would constitute an IUCN Category VI protected area (see also Mulongoy and Chape 2004). In practice this implies the realignment of the fence between Park and communal to incorporate part of the latter into a larger conservation area and the local community operating the conservation area as if it is a private nature reserve, though sharing the animals with the National Park, but, based on land tenure, the proceeds (after cost) from the land would be flowing to the community.

Method

Natural resource accounts have been indicated as powerful tools in addressing the information gap regarding the scope and magnitude of economy-environment interactions not captured through the conventional Systems of National Accounting, also in the context of a developing country (see Blignaut and De Wit 2004, Lange *et al*. 2003, Perrings and Vincent 2003 and Hassan 2002). Natural resource accounts attempt to augment conventional measures of economic activity by accounting for missing environmental values and integrating environmental and economic information in one unified framework for macroeconomic and environmental management. Such an integrated framework allows for the improved measurement of the contribution of environmental resources to economic well-being and for effective monitoring of the interactions between the environment and economic activity.

In addition to literature regarding natural resource accounts, the need for valuing biodiversity and ecosystem goods and services has been shown both internationally (Nunes *et al*. 2003, Pearce *et al*. 2002, Cervigni 2001 and Van Kooten and Bulte 2000) and locally (Reyers 2004, Frazee *et al*. 2003, Turpie 2003, Turpie *et al*. 2003, Wessels 2003, Milton 2003, Milton *et al*. 2003). A gap in our knowledge exists in applying a consistent and comprehensive framework of analysis of the value of biodiversity and ecosystem goods and services in two similar, yet differentiated, areas. Using a natural resource accounting framework, such a comparative analysis could be provided.

The literature quoted above fails to show the proper linkages between biodiversity structure, composition and function (or process). Biodiversity structure refers to the unique biome features of an area; composition refers to the specific diversity in species and species richness within an area. Biodiversity functions comprise life support (i.e. protection of soil erosion and watersheds), carrier (i.e. recreation), production (i.e. oxygen, water, nutrients and genetic resources) and information functions (i.e. aesthetic, historic and cultural values) (Nunes *et al.* 2003). A given area's biodiversity-related functions (or processes) are dependent on the quality and quantity of species that comprise the biodiversity composition of an area, which, in turn, determines the biodiversity structure. The omission of these distinctions from the national accounting literature could lead to either double counting or undercounting when considering the biodiversity value or the value of ecosystem goods and services. This distinction is not only necessary from an ecological, but also from an economic perspective. It would be inappropriate to mix values of different biodiversity structures since it would comprise mixing variables, and, also mixing composition values with that of function values would imply mixing stock values with flow values. By not differentiating between the various components one could also obscure the important link between keeping the capital stock (composition and structure) intact to ensure sustainable future flows (biodiversity function activities).

Since the Park and communal study areas are adjacent, separated only by a wire fence, they do belong to the same eco-region, namely the combined Lowveld Sour Bushveld and Lowveld Savanna (Acocks 1988). Comparison of composition and function are therefore straightforward, and appropriate. The study calculates the value of the standing stock of all tradable plant and mammal species to determine the value of the biodiversity composition for the two study areas (a tradable species is defined as a species traded in the market and for which there is a market value). In this context stock values refer to the accrued value of the natural capital over time, not unlike the treatment of fixed man-made capital stock in a conventional national accounting sense. Thereafter the value of the various biodiversity function components (direct use, non-consumptive and indirectly consumptive use) is calculated. These values are treated as flow variables, i.e. generating an annual stream of income or benefits to the owner(s) or beneficiary(ies) of the goods and services provided by the respective ecosystems. This is consistent with total economic value (Turner *et al.* 1994) and presented schematically in Figure 1. Direct use values are conceptually straightforward but not necessarily easy to measure in terms of money. The value of medical plants, for instance, is intensive, but possible, to measure. Indirect use values correspond closely to so-called 'ecological functions' (e.g. watershed protection, carbon sequestration, nutrient recycling). Option values are an expression of preference, a willingness-to-pay for the preservation of an environment against the probability that the individual will make use of it later (Pearce and Turner 1991: 130).

Bequest value measures an individual's willingness-to-pay to ensure the preservation of an environmental resource for the benefit of his/her descendants. Bequest values are non-use values for the current generation, but potential future use or non-use value for their descendants (Turner *et al.* 1994: 113). Existence value measures the willingness-to-pay for the preservation of the environment not related to either current or optional use, thereby being the only true 'non-use' value.

Results and discussion

Composition or stock of natural capital

As very little game now exists on the communal land and no survey of livestock has been undertaken, the value of animals could not be calculated.

For the adjacent area of the Park, densities of the main tradable mammal species were obtained from Zambatis and Zambatis (1997). The numbers were subsequently adjusted to reflect 2002/03 levels (SANParks 2003 and weighted to reflect the relatively high animal density in the Rooibos Bushveld area of the Park. This density adjustment was done based on expert opinion (J. Victor, D. Grobler and D. Cilliers, personnel communication, 2003), and a total stock of tradable mammals calculated (Appendix 1). Based on the most recent auction prices (differentiating between trophy animals and breeding herds) the total value of the tradable mammal stock was estimated to be $25.37 million or US$155.74/ha (Table 1). This is the market value should all the animals be liquidated at 2003 auction prices. Once the stock has been liquidated, the comparable value for the flows (*sic*. ecosystem function) is assumed to be zero, implying that recreational trade in game, for example through hunting, would be zero.

A list of tradable plant species was assembled from various sources (Van Zyl 2003, Hassan 2002, Botha *et al*. 2001, Shackleton and Shackleton 1997, 2000). Based on Netshiluvhi and Scholes (2001), Scholes *et al*. (2001) and Shackleton and Scholes (2000) the biomass per species and per hectare and for the whole Rooibos Bushveld area of the Park was calculated (Appendix 2). Based on these sources, it was also possible to specify the percentage of the biomass of each species used for various products. Based on the 2003 market prices for the various uses or products, it was possible to determine that the standing stock value of the tradable plant species, should they all be harvested completely amounts to US$481.3 million or US$2954.7 per hectare (see Table 1). Though this hypothetical amount is considerable, it still only accounts for the value of the standing biomass traded in the market. This does not incorporate the value of the non-traded species. The tradable plant stock value for the communal area was taken as 57% of the Park value applied to the communal land area size, since 43% per cent of the communal area was determined as being degraded.

Function or flow values

Direct use values

The direct or extractive and consumptive use of natural biota includes wood for construction and timber as well as for energy purposes, medicinal products, edible fruit, herbs, vegetables, thatch and the value of livestock and the hunting of game. Table 2 shows a summary of the direct use values for the areas under consideration, which will subsequently be discussed in more detail.

Rooibos Bushveld area of the Park

The Kruger National Park is according to the IUCN's classification, is a Category II national park, which, by definition, excludes the exploitation of natural resources. The direct use values for Rooibos Bushveld area of the Park are therefore zero. Despite this, one can ascertain the potential volumes of harvestable goods should the area be managed as a Category VI protected area, within which sustainable resource use is allowed.

Bushbuckridge communal area (Actual direct use values)

Various studies have been carried out to calculate the actual value of resource harvest in the Bushbuckridge communal area (Van Zyl 2003, Hassan 2002, Shackleton and Shackleton 2002, Netshiluvhi and Scholes 2001, Scholes *et al*. 2001, Botha *et al*. 2001, Shackleton and Shackleton 2000, Shackleton and Scholes 2000, Shackleton 1998, Shackleton and Shackleton 1997). These studies are based on primary household survey data. The heads of households were asked which products they were harvesting, their harvest rates and the going market prices for these products should they be bought rather than harvested. The values in Table 2 are based on a consolidation of data from these studies and have been adjusted to 2002/03 levels using the consumer price index.

The direct consumptive use value is estimated to be US$220 per hectare, or, alternatively, US$40.63 million for the whole study area (Table 2). This implies US$81.26 per person based on a beneficiary population of 500,000 (Hassan 2002). The major contributors to value from resource harvesting are the sales of livestock, edible fruit, herbs and vegetables as well as thatch and fuel wood.

Some households harvest resources for their own consumption; others sell them. It is not possible to distinguish between the number of harvesters and the number of buyers, but it as appears that a portion of the US$40.63 million discussed above are benefits in kind, i.e. resource extraction for own consumption. Irrespective of whether the resources are traded or harvested for own use, they are not recorded within the ambit of the formal economy and compilation of the GDP. This implies an underestimation of the GGP by US$40.63 million.

Bushbuckridge communal area (Potential direct use values)

Should the communal area be incorporated into the Park, but managed as an IUCN Category VI protected area that allows for the sustainable use of natural resources, mainly to support the livelihoods of local communities, then there would still be direct use, but under strict guidelines.

Shackelton and Shackelton (1997 and 2000) argue that the biomass production of the area under consideration is 3% per annum, but that not all biomass production is suitable for economic use, (see Appendix 2 for the distribution of tradable woody resources per species and the eligible component of each species by product). The sustainable harvest was conservatively assumed to be 1% of biomass for fuel wood, construction timber and branches and 0.5% for crafts and medicinal products (the assumption for crafts and medicinal plants is lower given the limited market options). The harvest of edible fruit comprises 50% of the full annual production. To calculate the volume of tradable biomass that can be harvested, the biomass per species and by product (from Appendix 2) was multiplied by either 1 or 0.5 per cent or the production volume and multiplied by the going market price.

Based on these assumptions (Table 2), the potential direct use values are US$611.35 per hectare, much of which is allocated to crafts and medicinal products, the two products with a considerable value-added component. The total size of the market is unclear and though it would be possible to generate the returns per hectare as indicated in Table 2, the possibility of realising these values over the whole study area is questionable because of market saturation. No value for livestock has been estimated since livestock would be excluded from the area, but trade in game would replace it and that is included. Trade in game (which includes hunting) has been restricted to the 50% of the number of new births per species per year to allow for natural off-take through predation and death and also to allow for replacement (Annexure 1).

Non-consumptive values

Non-consumptive values comprise those direct use values that are non-extractive in physical terms and here only tourism was considered for this activity. Tourism within the communal area is currently zero and to calculate the potential tourism value, the value of tourism to the adjacent area of the Park was calculated, expressed in terms of US$/ha, and applied to the communal area since we assume that tourism in the restored communal area is likely to be equivalent to that of the protected area.

Although the Rooibos Bushveld area comprises only 8% of the Kruger National Park (KNP), 24% of the parks tourist accommodation facilities are in this area. Calculation the total tourism value for the area (Table 3) is based on this proportion (SANParks 2003). The total number of visitors to the Rooibos Bushveld area of the Park was calculated as 254,189 per year. After distinguishing between day visitors and local and international overnight visitors, and assuming an average stay duration of 1.76 days per over night visitor, the total number of bed nights is estimated to be 213,207 per year. The total turnover value of visitors to this part of the Park, inclusive of gate fees, overnight accommodation and expenditure at Park stores, amounts to US$8.54 million. This translates to an average expenditure per visit of US$70.

It has been indicated that the travel cost method is an acceptable method to determine visitors' willingness-to-pay for the unaccounted amenities, or consumer surplus, for a recreation site (Dixon *et al*. 1994). After differentiating between the various local modes of travel and accounting for the average numbers of passengers per vehicle (based on Turpie and Joubert 2001), the total number of kilometres travelled in South Africa to and from the area is calculated as 28 million (this excludes any foreign travel). Given a crude average cost per travel of US$0.27/km (based on standard motor hire and Automobile Association estimates) the total cost of travel amounts to US$7.46 million. This implies a total tourism value of US$16 million, or US$98 per hectare. Based on information provided in SANParks (2003), it was possible to disaggregate the tourism value into its components of passive tourism (appreciation of scenic beauty and unclattered landscape), adventure tourism (direct use of landscapes such as hiking) and eco-tourism (the direct appreciation of biodiversity through bird and animal watching and botanical appreciation). Passive tourism is by far the largest.

Indirect consumption values

Indirect consumption values comprise, first, produced environmental goods and services useful to people and include honey production, carbon sequestration, livestock grazing and soil nutrient recycling, and, second, option and existence values which capture the possible future use of environmental goods and services from ecosystems. Regarding the first type it is considered inappropriate to include livestock grazing since the value of livestock sales is already included under direct consumptive use values and, also, livestock activities would not influence the potential value of the restored communal area. No data regarding soil nutrient recycling could be established. There are currently no formal honey production activities in either the Park or communal area, but based on an average of 20 kg per hive (Turpie *et al*. 2003) and 1 hive per 5 km^2 (Crewe, personnel communication, 2003) and an average price of US$4.56 per kilogram, the potential retail value of honey production is estimated to be US$0.85 million or US$4.56.

No formal market for carbon currently exists in South Africa. Carbon trading in Park would also not be feasible given the principle of additionality, which implies that carbon trading based on existing biomass does not count, since it does not contribute to additional carbon storage. The communal area area, however, has a good carbon trading potential. Based on a carbon absorption capacity of 4t/ha (Scholes and Van der Merwe 1996 and Scholes and Bailey 1996) and an average price for carbon of $15.7/t or $4.2/t CO_2, the potential value of the carbon sequestration market therefore amounts to US$12.31 million or US$66.87/ha.

Option, existence and bequest values have been defined above and are estimated simultaneously since distinguishing between them is seldom possible. A comprehensive study estimating the willingness-to-pay for conservation, either by contingent valuation and conjoint analysis, has not yet been done in South Africa. Results of two regional studies (Turpie 2003 and Turpie and Joubert 2001) are shown in Table 4 however.

Summary

The information provided above is summarised in Table 5. Though it was not possible to establish an actual value for the mammal stock in the Bushbuck Ridge communal area, the composition value of tradable vegetation is considerably below its potential given the degradation. With regard to biodiversity function-related activities, the actual extraction value is US$220.48 per hectare, but the potential is US$841.8, implying a net benefit of restoring the degraded land and conservation, i.e. the re-introduction of indigenous biomass and the appropriate management of the area, similar to that of the adjacent private protected areas, of US$621.34 per hectare.

Should one reduce the crafts and medicinal values, the value of tourism and the option and existence values by 50 per cent, one can determine how vulnerable the community would be to the non-realisation of these values. This alternative, a much more conservative scenario, yields an economic return of US$495.7/ha, that is US$275.1/ha more than the actual current value.

Conclusions and applications

The potential total economic value of the communal area under discussion is considerably higher than that of the actual value currently derived from the land. This is based on the premise that the area could be incorporated with the Kruger National Park, but with unchanged land tenure and allowing selective access to resource use. Such a system is possible given that even the IUCN recognises the possibility of having a protected area with selective resource use, and that there are privately-owned conservation units adjacent to the Park. Our result is fully consistent with that of Van Schalkwyk and Balyamujura (1996) who studied various land use scenarios within the same study area. This latter study did not quantify the benefits of alternative land use options, but reached their conclusion based on a multilevel criteria technique using a preference function to determine the most equitable, socially optimal and economically viable land use option among various scenarios.

There are however five possible problems, any one of which has the potential to spoil the viability of the proposed scheme. First, total economic value does not imply money in the pocket. It would be necessary to introduce a national system that would reward rural communities for providing ecosystem goods and services. High-level intervention is therefore required to create a market for the ecosystem goods and services, involving communities in a biodiversity conservation programme by developing the required incentive structures to promote biodiversity conservation and biodiversity beneficial land use practices.

The second potential pitfall is that market penetration for either the direct consumptive or indirect consumptive use products might be low. The only way to mitigate this problem is through a strong marketing campaign.

The third problem relates to management structure (see also Olukoye *et al*. 2003). Though it could be foreseen that the protected area will be managed by a professional service provider and the proceeds (after cost) from the protected area be centralised into a community-conservation fund and then recycled to the various community members, this arrangement will have to be negotiated and documented well and allow community buy-in. It has been mentioned that bad management systems will lead to failure of community conservation initiatives.

A fourth hurdle that will have to be overcome is that of insurance risk and the resultant cost. The concept as discussed here has not yet been tested in South Africa. Neither does an environmental investment sector exist and given the uncertainty surrounding global carbon sequestration markets, high insurance premiums on the sale of ecosystem goods and services could be expected. These premiums could act as significant barriers to trade. It could be argued, however, that the current degree of environmental degradation and the economic marginalisation of the communities involved were the result of various government and market failures. Government should therefore play an active role in providing the required incentive to rectify these failures.

The fifth consideration is that of the cost of restoration. Calculating this was not possible since the actual management and restoration plan would directly determine the cost of restoration, but should the cost exceed the economic benefits discussed here, then restoration would not make sense.

Based on the potential total economic value of the ecosystem goods and services derived from community conservation, this seems to be a plausible alternative to subsistence agriculture in Bushbuckridge. This conclusion has been reached using a natural resource accounting approach towards biodiversity valuation. From these calculations the value of the actual return from the current land use practice is estimated as amounting to US$220 per hectare, a portion of which is benefits in kind. The total economic value of community conservation has been estimated at US$841.8 per hectare and US$495.7 per hectare under conservative assumptions. The value of restoring degraded land is therefore considerable.

For the community to realise this potential increase in return from their land, solutions to various managerial and institutional challenges must be found. One such a solution might be the development of an environmental investment sector in the economy. Establishing such a sector could reduce insurance risk and link the suppliers of ecosystem goods and services and those in demand for such services much more readily, thereby reducing the transaction cost of such an activity.

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Appendix 1: Tradable mammal species in the Rooibos Bushveld area of the Kruger National Park

Species name	Common name	Ratios in saleable breeding units		Density of species	Numbers of individuals				Birth rate	Price	
		Female	Male	Animals / ha	Female	Male	Trophy	Total	%	Trophy (US$ per unit)	Food & Trade (US$ per breeding unit)
Hippotragus equinus	Roan Antelope	2	1	0.00006	7	4	1	11	10	5530	14029
Connochaetes taurinus	Blue wildebeest	7	3	0.010255	1 257	539	84	1 890	12	338	252
Tragelaphus scriptus	Bushbuck	8	2	0.0009	126	32	7	166	8	557	485
Syncerus caffer	Buffalo	6	2	0.018	2 364	788	147	3 317	8	9574	22363
Taurotragus oryx	Eland	8	2	0.0003	42	11	2	55	7	1017	661
Crocuta crocuta	Spotted hyena	1	1	0.0012	105	105	9	221	12	988	1311
Acinonyx jubatus	Cheetah	1	1	0.00012	11	11	1	22	17	2280	429
Giraffa camelopardalis	Giraffe	2	1	0.005697	665	332	46	1 050	7	1397	2167
Tragelaphus strepsiceros	Kudu	7	3	0.004558	559	239	42	840	8	654	268
Panthera leo	Lion	4	1	0.0012	168	42	11	221	21	3494	8114
Panthera pardus	Leopard	1	1	0.0006	53	53	6	111	6	1520	504
Tragelaphus angasii	Nyala	12	3	0.00018	25	6	2	33	8	1584	883
Loxodonta africana	Elephant	5	1	0.006275	916	183	58	1156	4.5	4559	7909
Ceratotherium simum	White rhinoceros	1	1	0.004558	399	399	42	840	4.5	19042	23351
Diceros bicornis	Black rhinoceros	4	2	0.0003	35	20	0	55	4	n/a	68389
Redunca arundinum	Reedbuck	3	1	0.00009	12	5	0	17	12	n/a	304
Aepyceros melampus	Impala	8	2	0.086598	12 130	3 032	798	15 960	17	153	93
Hippopotamus amphibius	Hippopotamus	3	1	0.002114	278	112	0	390	6	n/a	6079
Hippotragus niger	Sable antelope	3	1	0.00018	24	8	2	33	9	6435	18566
Phacochoerus aethiopicus	Warthog	7	3	0.002279	279	141	0	420	20	n/a	128
Kobus ellipsiprymnus	Waterbuck	8	2	0.003418	479	120	31	630	10	1116	773
Lycaon pictus	Wild dog	8	2	0.00012	17	4	1	22	0	0	0
Equus burchelli	Zebra	4	1	0.022789	3 192	1 008	0	4 200	9	456	669

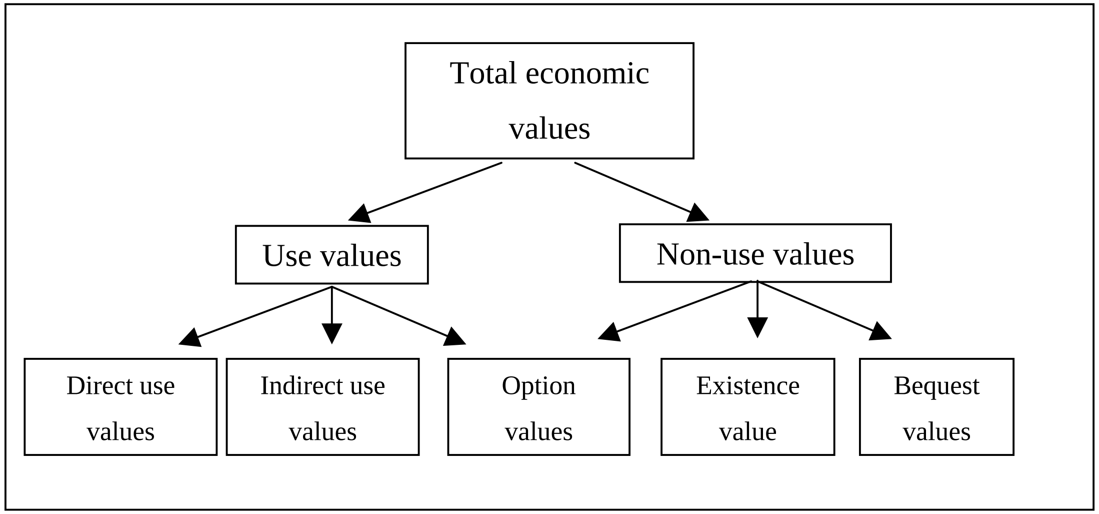
Sources: Own calculations based on SanParks (2003), Zambatis, G. and N. Zambatis (1997), Victor, J. (personnel communication, 2003), Grobler, D. (personnel communication, 2003), Cilliers, D. (personnel communication, 2003), Van Aarde, R. (personnel communication, 2003), Game and Hunt (2003).

Appendix 2: Key data inputs of tradable plant species in the Rooibos Bushveld

Species name	Common name	Density of species	Number of individuals	Diameter	Biomass	Biomass	Fuel wood	Construction timber	Crafts	Branches	Waste	Edible fruit	Medicinal products
		Specimens / ha)	Number	mm	kg / tree	t/ha	First row: Product as % of biomass or as volume per specimen (economic yield) and Second row: Price of product in US$/kg (2002/03 values)						
Sclerocarya birrea	Marula	14	2280656	500	829.04	11.61	0.30	0.20	0.01	0.10	0.39	50kg/female tree	0.01
							0.05	0.10	3.80	0.05	0.00	0.04	2.43
Ziziphus mucronata	Buffalo thorn	16	2606464	300	172.53	2.76	0.30	0.30	0.01	0.10	0.39	0.00	0.01
							0.05	0.10	3.80	0.05	0.00	0.04	2.43
Grewia bicolor	Bastard Brandybush	13	2117752	30	285.28	3.71	0.5	0	0	0	0.5	0	0
							0.05	0.10	3.80	0.05	0.00	0.04	0
Lannea schweinfurthii	False marula	2	325808	450	629.25	1.26	0.40	0.30	0.00	0.00	0.30	0.00	0.01
							0.05	0.10	3.80	0.05	0.00	0.04	2.43
Diospyros mespiliformis	Jakkalsbessie	2	325808	900	2689.52	5.38	0.20	0.40	0.00	0.10	0.30	14 kg/t biomass/ha	0.01
							0.05	0.10	3.80	0.05	0.00	0.04	2.43
Carissa edulis	Natal plum	4	651616	20	101.20	0.40	0.50	0	0	0	0	14 kg/t biomass/ha	0
							0.05	0.10	3.80	0.05	0.00	0.04	0
Acacia nigrescens	Knob-Thorn	7	1140328	450	434.17	3.04	0.20	0.30	0.01	0.10	0.39	0.00	0.00
							0.05	0.10	3.80	0.05	0.00	0.04	0.00
Acacia nilotica	Scented thorn	22	3583888	400	585.35	12.88	0.40	0.20	0.00	0.10	0.30	0.00	0.00
							0.05	0.10	3.80	0.05	0.00	0.04	0.00
Acacia tortillis	Umbrella thorn	2	325808	200	275.89	0.55	0.70	0.00	0.00	0.00	0.30	0.00	0.00
							0.05	0.10	3.80	0.05	0.00	0.04	0.00

Sources: Adapted from: Scholes *et al*. 2001, Van Zyl 2003, Netshiluvhi and Scholes 2001, Shackleton and Shackleton 1997, Shackleton and Shackleton 2000, Hassan 2002.

Figure 1: Values of an ecosystem



Source: Adapted from Turner *et al*. 1994.

Table 1: Value of all tradable mammals and plants in Rooibos Bushveld area of the Kruger National Park: 2002/03

Species name	Common name	Total value (US$ 1000)			Unit value (US$ /ha)
		Trophy	Breeding units	Total	
Hippotragus equines	Roan antelope	3	43	46	0.28
Connochaetes taurinus	Blue wildebeest	28	40	68	0.42
Tragelaphus scriptus	Bushbuck	4	7	11	0.07
Syncerus caffer	Buffalo	1404	7787	9191	56.42
Taurotragus oryx	Eland	2	3	6	0.03
Crocuta crocuta	Spotted hyena	10	183	193	1.19
Acinonyx jubatus	Cheetah	2	42	45	0.27
Giraffa camelopardalis	Giraffe	65	637	702	4.31
Tragelaphus strepsiceros	Kudu	24	19	43	0.27
Panthera leo	Lion	34	649	683	4.19
Panthera pardus	Leopard	7	141	149	0.91
Tragelaphus angasii	Njala	2	2	4	0.02
Loxodonta africana	Elephant	233	2952	3185	19.55
Ceratotherium simum	White rhinoceros	707	8236	8943	54.9
Diceros bicornis	Black rhinoceros	0	557	557	3.42
Redunca arundinum	Reedbuck	0	1	1	0.01
Aepyceros melampus	Impala	108	124	232	1.42
Hippopotamus amphibious	Hippopotamus	0	523	523	3.21
Hippotragus niger	Sable antelope	9	129	139	0.85
Phacochoerus aethiopicus	Warthog	0	5	5	0.03
Kobus ellipsiprymnus	Waterbuck	31	41	72	0.44
Lycaon pictus	Wild dog	0	18	18	0.11
Equus burchelli	Zebra	85	472	557	3.42
Total		**2758**	**22611**	**25373**	**155.74**

Species name	Common Name	Total value (US$ million)	Unit value (US$/ha)
Sclerocarya birrea	Marula	194.12	1191.6
Ziziphus mucronata	Buffalo thorn	50.37	309.2
Grewia bicolor	Bastard brandybush	13.77	84.54
Lannea schweinfurthii	False marula	15.17	93.14
Diospyros mespiliformis	Jakkalsbessie	70.51	432.86
Carissa edulis	Natal plum	1.54	9.44
Acacia nigrescens	Knob thorn	41.16	252.65
Acacia nilotica	Scented thorn	91.82	563.64
Acacia tortillis	Umbrella thorn	2.87	17.61
Total		**481.3**	**2954.7**

Source: Adapted from Annexes 1 and 2.

Table 2 Comparison of direct use values for the Rooibos Bushveld area of the National Park land, with actual values for communally-owned land (BBR) under subsistence management and its potential values following restoration of natural capital: 2002/03

	Rooibos Bushveld			**BBR (Actual)**			**BBR (Potential)**		**Difference (potential less actual)**
	Ha	**US$ millions**	**US$/ha**	**Ha**	**US$ millions**	**US$/ha**	**US$ millions**	**US$/ha**	
Fuel wood	162 904	0	0	184 301	5.76	31.24	3.50	18.96	-12.28
Timber	162 904	0	0	184 301	2.70	14.65	4.41	24.01	9.36
Crafts	162 904	0	0	184 301	0.25	1.34	51.22	278.22	276.89
Medicinal	162 904	0	0	184 301	4.78	25.92	47.11	255.38	229.46
Edible fruit, herbs and vegetables	162 904	0	0	184 301	9.28	50.36	1.51	8.19	-42.17
Thatch	162 904	0	0	184 301	7.01	38.02	0.61	3.19	-34.82
Livestock	162 904	0	0	184 301	9.38	50.88	0.00	0.00	-50.88
Wild animals	162 904	0	0	184 301	0.00	0.00	4.3	23.4	23.4
Other: Reeds, sticks, grass brushes, birds, etc.	162 904	0	0	184 301	1.49	8.08	0.00	0.00	-8.08
Total direct consumptive use	**162 904**	**0**	**0**	**184 301**	**40.63**	**220.48**	**112.6**	**611.35**	**390.88**

Sources: Adapted from: Scholes *et al*. 2001, Van Zyl 2003, Netshiluvhi and Scholes 2001, Shackleton and Shackleton 1997, Shackleton. and Shackleton 2000, Hassan 2002.

Table 3: The value of tourism for the Rooibos Bushveld area of the Kruger National Park: 2002/03

Number of overnight visitors	Number of day visitors	Number of foreign visitors	Number of SA overnight visitors	Total number of visitors	Total number of bed-nights	Turnover (incl. gate fees, shops & accomm.) (US$ million)	Ave exp / person (US$)	Ave exp / night (US$)	Ave exp / visit (US$)
121 377	132 812	67 345	54 032	254 189	213 208	8.54	33.59	40.12	70.36

Table 3 (cont).

					Tourism modes				
Total vehicle km travelled (million km)	Cost of travel / unit (US$ / km)	Travel cost (US$ million)	Ave. travel cost / visitor (US$)	Total willingness-to-pay (US$ million)	Passive (US$ million)	Adventure (US$ million)	Eco-Tourism (US$ million)	Total ave. value / person (US$)	US$/ha
28	0.27	7.46	29.33	16	13.54	0.38	2.08	62.92	98.18

Source: Own calculations based on SANPArks (2003).

Table 4: Option and bequest values for the Rooibos Bushveld area of the Kruger National Park

Turpie (2003)	**Nature conservation value for SA: based on regional study and extrapolated to national value ($ million)**	**SA nature conservation surface area (state control) (ha)**	**Option & existence value of RBV: based on area size ($ million)**	**Option & existence value ($/ha)**	**Average option and bequest value ($/ha)**
	399.696	7 371 864	8.815	54.255	
Turpie and Joubert (2001)	**KNP consumer surplus ($ millions)**	**Proportion of RBV visitors to total visitors**	**Option & existence value of RBV: based on number of visitors ($ million)**	**Option & existence value ($/ha)**	
	45.745	24%	10.942	67.477	60.83

Sources: In Table.

Table 5: Comparison of the total economic value of National Park land under conservation, with communally-owned land (BBR) under subsistence management and following restoration of natural capital

Value of the standing stock at prevailing market prices									
	Park (Rooibos Bushveld)			BBR Subsistence (Actual)			BBR Restored (Potential)		BBR diff (US$/ha)
	Size of area	Total value (US$ million)	Value (US$/ha)	Size of area	Total value (US$ million)	Value (US$/ ha)	Total value (US$ million)	Value (US$/ha)	Potential less actual
Mammals	162 904	25.38	155.74	184 301	n/a	n/a	28.72	155.74	n/a
Vegetation	162 904	483.43	2967.98	184 301	311.70	1691.49	546.96	2967.98	1365.50
Total value	**162 904**	**508.81**	**3123.72**	**184 301**	**311.70**	**1691.49**	**575.68**	**3123.72**	**n/a**
Biodiversity function or flow values									
Direct consumptive	**162 904**	**0**	**0**	**184 301**	**40.58**	**220.48**	**112.6**	**611.35**	**390.88**
Direct non-consumptive: Tourism	**162 904**	**15.96**	**98.25**	**184 301**	**0**	**0**	**18.09**	**98.25**	**98.25**
Total indirect consumptive use	**162 904**	**20.82**	**127.66**	**184 301**	**0**	**0**	**24.41**	**132.22**	**132.22**
Indirect-consumptive (Type 1)									
Honey production	162 904	0	0	184 301	0	0	0.85	4.56	4.56
Carbon sequestration	162 904	10.94	66.87	184 301	0	0	12.31	66.87	66.87
Indirect-consumptive (Type 2)									
Option & existence values	162 904	9.91	60.83	184 301	0	0	11.25	60.83	60.83
Function: Grand total	**162 904**	**36.78**	**225.95**	**184 301**	**40.58**	**220.48**	**155.15**	**841.8**	**621.34**
Function: Total of alternative scenario	**162 904**	**36.78**	**225.95**	**184 301**	**40.58**	**220.48**	**91.3**	**495.7**	**275.1**

Source: Derived from Tables 1-4.