Economic Valuation of the uKhahlamba Drakensberg Park World Heritage Site

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Executive Summary

Although there is widespread agreement on the importance of maintaining natural areas and their associated flora and fauna, the total area given protected status in KZN is less than required, and the level of funding provided for management is inadequate. A major reason for this is that the benefits to society from protected areas are often grossly underestimated, and the immediate costs of protection appear large in comparison. Economics can play a key role in improving estimation and understanding of the real values of protected areas, and this information can, in turn, be used to justify increasing the extent of protected areas and providing larger budgets for their management.

The concept of Total Economic Value (TEV) is now a well established and useful framework for identifying the various values associated with protected areas. The total economic value of a protected area consists of its use values (direct use values, indirect use values, and option values) and non-use values (bequest values and existence values). However, calculating the total economic value of a protected area is an extensive exercise that would be very costly, time-consuming, and beset with practical difficulties.

The aim of this report is to illustrate and quantify some of the economic values of the uKhahlamba Drakensberg Park World Heritage Site (UDP WHS) within the TEV framework and terminology, with the aim of providing a glimpse of the potential value of the Park to society and the economy, and an indication of the return on investment by Provincial government. The four values that have been calculated and are reported on in this report are water supply regulation (indirect use value), carbon sequestration (indirect use value), rock art (non-use existence value) and tourism (direct use value).

It is clear that the UDP WHS offers services to society that are of significant value; converting this to monetary values through different accepted economic methods gives a better indication of the magnitude of these values, which are summarised in Table 1.

Table 1: Summary of some economic values (water supply regulation, carbon, rock art and tourism) for the UDP WHS (Rands)

Service	Minimum value	Maximum value
Water (asset value)	47,522,800	4,158,154,956
Water supply regulation (per annum)	22,980,000	113,250,000
Carbon (NPV)	68,888,976	103,320,041
Rock art (monetary value per annum)	9,839,726	13,427,000
Rock art (existence value per annum)	514,492,000	
Tourism (direct spend per annum)	208,000,000	

It is apparent that the value of (the services provided by) the Park far exceed the management costs. To illustrate this, the UDP WHS costs the provincial government approximately R20 Million net per annum. Taking the value of one service, that of water supply regulation, the state is investing only 1.86% of the asset value in maintenance/management of that asset (c. R20Million vs. c. R1Billion asset value); under some assumptions that investment is as low as 0.48% (c. R20Million vs. R4.1Billion asset value). Good business practice dictates that at least 10% of the asset value should be invested per annum in maintenance of an asset. It is therefore clear that the KZN province is significantly under-investing in maintenance of a key strategic asset. Some of the implications of the under-investment are already becoming apparent, and include increases in alien plant infestation (resulting in lower water production), uncontrolled soil erosion (leading to reduction in water quality), collapsing boundary fencing (resulting in incursion of livestock and accelerated erosion), and fire damage to rock art (resulting in a loss of cultural heritage). All of these ultimately have the potential to result in the loss of World Heritage Status, and ultimately to a loss of the economic value provided to KZN by the World Heritage status.

Whilst appreciating the economic values that have been calculated, it is important to note that the value of only two ecosystem services have been quantified vis. water supply regulation and soil carbon. There are another 33 ecosystem services that have been identified, but not valued, for the Park. As many of the benefits associated with ecosystem preservation (ecosystem services) are undervalued by the market, market information will lead governments to socially inefficient land use decisions. Correcting for market and government failure in the Drakensberg region requires both accurate information regarding the value of the services, as well as development of policies and funding mechanisms that will ensure that the services continue to be delivered, and certainly not compromised. As the scarcity of ecosystem services increases with land conversion, unsustainable use and climate change, not only will there be a greater demand for these services but new markets will be created to sell these services. Water security and carbon sequestration are the two new services on the market which can feasibly be traded, and these emerging tradable services could constitute a new revenue stream for the Park.

Introduction

Although there is widespread agreement on the importance of maintaining natural areas and their associated flora and fauna, the total area given protected status is less than required, and the level of funding provided for management is almost always inadequate to do the job (Dixon & Sherman 1991, Carbutt & Goodman 2010). A major reason for this is that the benefits to society from protected areas are often grossly underestimated, and the immediate costs of protection appear large in comparison. Economics can play a key role in improving estimation and understanding of the real values of protected areas, and this information can, in turn, be used to justify increasing the extent of protected areas and providing larger budgets for management (Dixon & Sherman 1991).

The concept of Total Economic Value (TEV) is now a well established and useful framework for identifying the various values associated with protected areas (IUCN 1998). The total economic value of a protected area consists of its use values and non-use values. A protected area's use values are in turn made up of its direct use values, indirect use values, and option values. Non-use values include bequest values and existence values (Figure 1). Economic valuation, based on economic value, measures market and non-market values that people hold for a protected area (IUCN 1998).

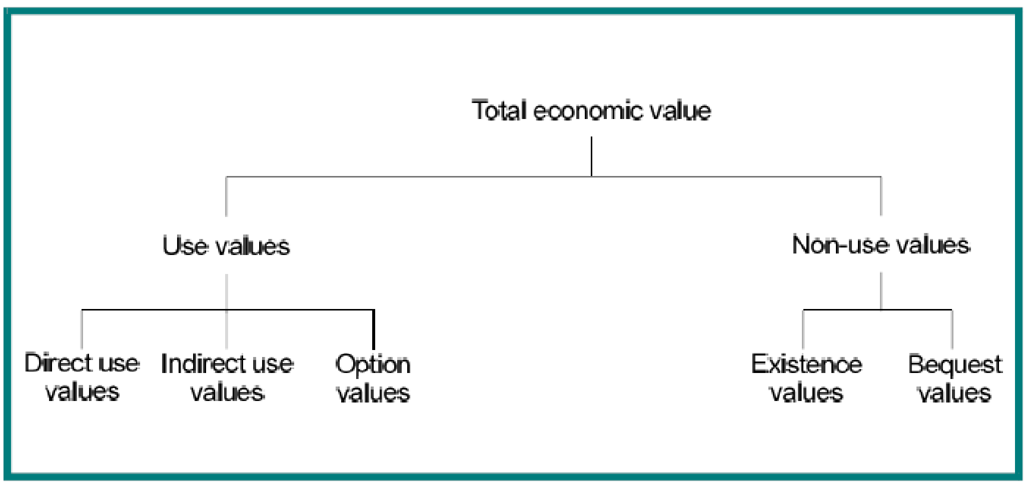

Figure 1 Elements contributing to the Total Economic Value of a protected area (from IUCN 1998).

Definitions of the different uses are summarised in IUCN (1998). The **direct use values** of a protected area are values derived from the direct use of the protected area for activities such as recreation, tourism, natural resource harvesting, hunting, gene pool services, education and research. These activities can be commercial, meaning they are traded on a market (resource harvesting and tourism), or non-commercial, meaning there is no formal or regular market on which they are traded (fuelwood collection and informal grazing). The value of commercial uses will generally be a straight-forward process of directly obtaining market-priced values. However, if these prices are administratively set, they may not reflect the true value for the product. Valuing non-commercial uses is more complex and entails a range of techniques which solicit values for goods and services of a roughly comparable nature from other markets.

The **indirect use** values of a protected area are values derived from the indirect uses of the protected area. Indirect uses are largely comprised of the protected area's ecological functions such as watershed protection, breeding habitat for migratory species, climatic stabilisation and carbon sequestration. Protected areas also provide natural services, such as habitat for insects which pollinate local crops or for raptors which control rodent populations. Indirect use values are often widely dispersed and thus go unmeasured by markets. Alternative valuation techniques are necessary for measuring them.

The **option** values of a protected area are values derived from the option of using the protected area sometime in the future. These future uses may be either direct or indirect and may include the future value of information derived from the protected area. Future information is often cited as particularly important for biodiversity as untested genes may provide future inputs into agricultural, pharmaceutical or cosmetic products.

Non-use values are values which humans hold for a protected area which are in no way linked to the use of the protected area. Two common examples of non-use values are **bequest** values and **existence** values. Bequest values relate to the benefit of knowing that others benefit or will benefit from the protected area. Existence values reflect the benefit of knowing that the protected area exists even though one is unlikely to visit it or use it in any other way. Non-use values are particularly difficult to measure.

As many of these goods and services are not traded on commercial markets and therefore have no evident market value, the values of these non-market goods and services need to be measured and expressed in monetary terms, where possible, so that they can be weighed on the same scale as commercially traded components. Various methods have been developed to convert non-market values to equivalent market values, and each method has its own strengths and limitations.

Figure 2 provides examples of the types of values attributed to protected areas.

Total economic values of protected areas				
Use values			Non-use values	
Direct use value	Indirect use value	Option value	Bequest values	Existence values
Recreation	*Ecosystem services*	Future information	Use and non-use values for legacy	*Biodiversity*
Sustainable harvesting	*Climate stabilisation*	Future uses (indirect and direct)		Ritual or spiritual values
Wildlife harvesting	*Flood control*			Culture, heritage
Fuel-wood	Ground-water recharge			Community values
Grazing	*Carbon sequestration*			Landscape
Agriculture	Habitat			
Gene harvesting	Nutrient retention			
Education	Natural disaster prevention			
Research	*Watershed protection*			
	Natural services			

Source: Adapted from Barbier *et al.*, (1997)

Figure 2 Examples of the types of values derived from protected areas (IUCN 1998). Those highlighted in red are quantified in this report for the uKhahlamba Drakensberg Park World Heritage Site. 'Ecosystem services' can be unpacked to a large number of individual goods and services.

Calculating the total economic value of a protected area is an extensive exercise that would be very costly, time-consuming and difficult. Further, any attempt to calculate an actual total economic value for a protected area is likely to be burdened with problems of missing values, conflicting values and double counting (IUCN 1998).

It will take time to do a full economic evaluation of the UDPWHS. The aim of this report is to illustrate and quantify some of the Park values, thereby giving a glimpse of the potential value of the Park to society and the economy, and an indication of the return on investment by Provincial government. Four of the values that have been calculated in the last five years include water (indirect use value), carbon sequestration (indirect use value), rock art (non-use existence value) and tourism (direct use value), each of these will be summarised in separate sections of this report below. Each section is broken down into an **Introduction**, a brief summary of **Methods**, and a summary of major **Results**.. The source of all information is described and readers can consult the original reports described in the **Full Reference List** for more detailed descriptions of methods, assumptions and results.

Water

Key references

MDTP (Maloti Drakensberg Transfrontier Project). 2007. Payment for Ecosystem Services: Developing an Ecosystem Services Trading Model for the Mnweni/Cathedral Peak and Eastern Cape Drakensberg Areas. Mander (Ed.) INR Report IR281. Development Bank of Southern Africa, Department of Water Affairs and Forestry, Department of Environment Affairs and Tourism, Ezemvelo KZN Wildlife, South Africa.

Mander, M., Diederichs, N. and van Niekerk, M. 2009. Ezemvelo KZN Wildlife Protected Area's Ecosystem Services. Durban: FutureWorks.

Pillay, D. 2010. Market Failure in the Provision of Water Supply Regulation Services in the Maloti-Drakensberg Mountain Range: Examining Some Potential Solutions. Unpublished Honours thesis, School of Economics and Finance, University of KwaZulu-Natal, 82 pp.

Introduction

Relative to human-engineered alternatives, the water supply regulation service provided by the Drakensberg ecosystem is a cost effective means of supplying water (MDTP 2007). Though evidence suggests that support of, and even expansion of, current conservation efforts would be socially optimal, degradation of the UDPWHS and larger Drakensberg system continues to occur (Blignaut et al. 2010). The fundamental cause of these non-optimal land management practices is both government and market failure.

Communal rangelands in the Drakensberg are subject to a range of agricultural activity that is both unsustainable and economically inefficient. Incorrect fire management, as well as the combination of inappropriate grazing management regimes and improper stocking rates all contribute to vegetation loss and soil erosion in unprotected areas (Blignaut et al. 2010). These negative impacts not only affect water supply regulation and flood attenuation services, but also lead to silt build-up in dams, a loss of biodiversity, and a loss of carbon storage and carbon sequestration services (Blignaut et al. 2010). Well managed conservation areas, such as the UDPWHS, on the other hand have positive impacts on water supply regulation, water quality and flood attenuation (MDTP 2007).

The purpose of this section is to report on the enhanced (relative to communal rangelands) yearly flow estimates derived from the presence of the UDPWHS, and then to use this to calculate an asset value of the Park.

Methods

The hydrological model ACRU was used to simulate runoff under different management scenarios with combinations of grazing and fire treatments (MDTP 2007). The annual production and annual value estimates for the water supply regulation service were calculated based on potential tariff revenue as well as use of the water by different combinations of beneficiaries (MDTP 2007). A yearly flow estimate corresponds to the benefits provided by the ecosystem service in a single year, providing important information regarding the annual contribution of the ecosystem to economic activity.

The asset value of an ecosystem service on the other hand is the sum of the future stream of benefits provided over the lifetime of the ecosystem providing the service. Because individuals give less weight to future benefits than current benefits, all future benefits need to be discounted appropriately. The asset value of the water supply regulation was then calculated under different discount rate assumptions and time periods (Pillay 2010).

A range of discount rates were included in the analysis to reflect the sensitivity of the results to the choice of discount rate. Five alternative discount rates are used: 2.5% (the lower-limit Social Time Preference Rate); 5% (the upper-limit Social Time Preference Rate); 8% (the most commonly applied discount rate in South Africa); 9.5% (the Social Opportunity Cost of Capital); and 10.1% (the social discount rate for public sector projects conducted between 1996 and 2000) (Du Preez 2004).

Results

MDTP (2007) have estimated the yearly value of the water supply regulation service provided by the UDPWHS. The value of this ecosystem service is approximately R4,800,000 per annum based on the value of tariff revenues. Value estimates are also made using the production function approach, which values an ecosystem service according to the value added to the production process. Under the assumption that the water provided by the regulation service goes only to low value users (agriculture), the service is valued at R22,980,000 per annum; if the water is sold to medium value users (mixed agriculture and households), the value of the service increases to R54,000,000 per annum; if the water is sold to high value users (industry), the service is valued at R113,250,000 per annum. The above values are all in 2008 prices.

Table 1: Annual value (Rands) of the water supply regulation service provided by the UDPWHS. High = use by industry; Medium = mixed agriculture and household use; Low = agricultural use only; tariff = water tariff value

High	Medium	Low	Tariff
113,250,000	54,000,000	22,980,000	4,800,000

Depending on the assumptions made, the UDPWHS has a water supply regulation asset value of R47,220,150 to R4,530,000,000 (Pillay 2010). The large difference associated with these lower and upper estimates stems from the degree of uncertainty regarding a number of key variables. An analysis of the data reflects the fact that alternative time period assumptions within the fifty year to infinity range have a relatively small impact on the final asset value, this is especially true when a high discount rate is applied. For reasonable lifetime estimates of the ecosystem service, it is the yearly value of the ecosystem service and the discount rate applied to these values which are crucial in determining the final asset value (Table 2).

Using a five percent discount rate , a hundred year ecosystem service lifespan and the medium annual service value estimate for the UDPWHS, **the water supply**

regulation service asset value of the UDPWHS is conservatively calculated as R1,072,723,017.

Table 2: Water supply regulation service asset values (Rands) based on different discount rates in relation to yearly value estimates of the water supply regulation service for the UDPWHS (2008 Prices) (from MDTP 2007, Pillay 2010). High = use by industry; Medium = mixed agriculture and household use; Low = agricultural use only; tariff = water tariff value

Discount rate measure	Discount rate	High	Medium	Low	Tariff
STPR – Low	0.025	4,158,154,956	1,982,696,403	843,747,469	176,239,680
STPR – High	0.05	2,249,738,550	**1,072,723,017**	456,503,240	95,353,157
	0.08	1,415,150,111	674,773,563	287,153,638	59,979,872
SOCC	0.095	1,192,016,032	568,378,505	241,876,631	50,522,534
SDR/PSCP	0.101	1,121,241,067	534,631,502	227,515,406	47,522,800

Rock Art

Key references

Duval-Massaloux, M. 2010. Rock Art Management and Heritage Tourism in the uKhahlamba-Drakensberg. Unpublished report for Ezemvelo KZN Wildlife.

Topp, T. 2009. The Value of the San Rock Art in the uKhahlamba Drakensberg World Heritage Site (South Africa). Unpublished M.Sc. thesis, University of Klagenfurt, Austria, 84 pages.

Introduction

One of the main reasons for the UDP attaining World Heritage Site status was the exceptional concentration and diversity of San rock art. These resources were previously thought to have only intrinsic value and are not traded on markets, but economic methods now allow for estimation of the monetary value to the Park or society of these.

The contingent valuation method (CVM) uses a direct approach to valuing an environmental good or service in that it asks people through surveys or experiments what they are willing to pay for the good or willing to accept for the loss of the good. Contingent valuation is particularly attractive because it can estimate values where markets do not exist or where market substitutes cannot be found. For these reasons, CVM is widely used to measure existence values, option values, indirect use values and non-use values.

Using the ‘Total Economic Value Model’ (Figure 1) as a guideline it is clear to see that a willingness to pay to protect rock art is a non-use value of ‘existence’ and ‘bequest value’ to the Park.

The aim of this section is to summarise the findings of two studies that calculated the realised income form rock art, the potential monetary value of this rock art, and finally the existence value of the rock art to South Africans.

Methods

In order to apply a monetary value to the rock art of the UDPWHS the contingent valuation method (CVM) was used by Topp (2009) who undertook visitor surveys to measure the visitors willingness to pay more to enter the Park (on their entry fee or as an additional levy) in order to protect the rock art, and secondly, to measure their willingness to pay for guided tours to the paintings.

Actual income was calculated from records kept by EKZNW at the various sites where guided access is permitted (Duval-Massaloux 2010).

Existence value was calculated as the product of average South African visitor willingness to pay and the population size of South Africa (Topp 2009). It could however be argued that as the rock art is an international asset (and hence listed as a World Heritage Site) that the value extends to the entire world population.

Results

Monetary value

The potential **annual monetary value of the San Rock Art in the UDPWHS is between R9,839,726 and R13,427,000 per year**, made up of visitors WTP to protect the paintings (R5,788,000 per year) and visitors WTP to visit the paintings (between R4,051,726 and R7,639,000 per year) (Topp 2009). Approximately 27 000 tourists visited rock art sites in the UDPWHS in 2009, and the **actual realised income from rock art tourism (including the entrances fees, commissions, Didima Rock Art Centre revenue, Game Pass movie) is between R1,218,823 and R1,425,213** (2009 values) (Duval- Massaloux 2010).

Existence Value

The existence value of the paintings in the Drakensberg to South Africans hypothetically equals R10,63 per person per year (Topp 2009). When multiplied by the total estimated population of South Africa it gives the rock art a **hypothetical existence value of R 514,492,000 per year.**

Carbon

Key reference

Knowles, T., von Maltitz, G. and Makhado, M. 2008. The uKhahlamba Drakensberg Park World Heritage Site carbon sequestration project feasibility study implementation report. EKZNW unpublished report, 60 pp.

Introduction

The UDPWHS is carefully managed and retains its original soil carbon stocks, whereas neighbouring communal areas are overstocked and have lost significant amounts of topsoil, and with it the soil carbon. Trade in soil carbon is a relatively new part of the global carbon trade, and has not been successfully undertaken in a South African context yet. Despite the challenges in getting a trade going, including the difficulty of demonstrating additionality and avoiding leakage, one could argue that the carbon saved by the protected area has the equivalent value to society. Practical issues would need to be resolved prior to successfully realising any of this value.

This section summarises the findings of Knowles et al. (2008) with respect to the per unit area quantities of soil carbon in the Park in comparison to the alternative land use, that of communal livestock grazing.

Methods

Soil samples collected at three catenal positions (upslope, midslope and valley bottom) within the northern parts of the UDPWHS and equivalent areas in a neighbouring communal rangeland. These samples were analysed for soil carbon in the top 30 cm of the soil profile. The value of the carbon in the protected area was calculated taking into account costs of entering the trade and under a range of realistic assumptions in terms of carbon sequestration and discount rates (Knowles *et al*. 2008).

Results

The UDPWHS has significantly more carbon in the soil than neighbouring communal areas. The magnitude of the difference in carbon stocks between conservation and communal areas is 230 tCO_2/ha_{30} [a] for the mid-slope catenal position and 198 tCO_2/ha_{30} for the upper plateau areas respectively (Knowles *et al*. 2008).

[a] Soil carbon per hectare within top 30 cm of soil converted to CO_2 equivalents

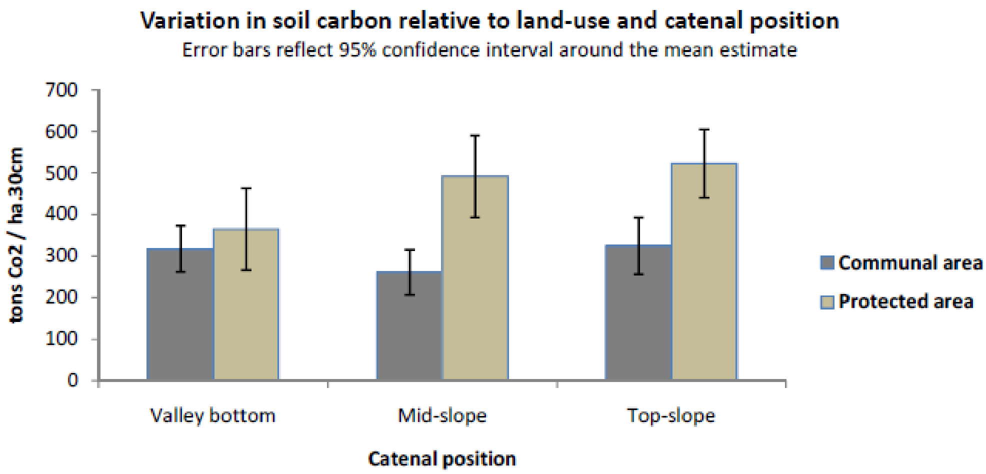

Figure 3 Variation in soil carbon (converted to CO_2 equivalents) in the Drakensberg in relation to land use and catenal position.

Assuming a price of US$10 / tCO_2e [b] the **Net Present Value of the soil carbon stock in the UDPWHS is between R103,320,041 (at 4% discount rate) and R68,888,976 (at 8% discount rate).** Expressed in another way it is worth between R154/ha (4% discount rate) and R103/ha (8% discount rate).

The study concluded that it would be feasible to enter the carbon trade in terms of the additional sequestration model for communal rangelands and as an avoided degradation for the Park itself, and that these ventures have the potential to completely cover or at least significantly contribute to the cost of conserving the Drakensberg area (Knowles et al. 2008).

[b] US$10 for the amount of carbon equivalent to one ton of atmospheric carbon dioxide (CO_2)

Tourism

Key reference

TKZN (Tourism KwaZulu-Natal). 2009. The values of World Heritage Sites. Tourism KwaZulu-Natal Occasional Paper No. 68., 11 pp.

Introduction

Tourism KZN has investigated the value of World Heritage Sites to the province of KwaZulu-Natal, and has estimated the direct use value (money spent) of the UDPWHS (TKZN 2009). The findings are presented in this section of the report.

Methods

It has been estimated elsewhere that domestic tourists spend approximately R112 per night and have an average stay length of 4.1 nights, although the mode is a stay length of 2 nights. It is assumed that half of the visitors to the Drakensberg region entered the Park. Foreign visitors spend in the region of R1000 per day and thus with an average length of stay of 5.7 nights in the province. It is assumed that all foreign visitors entered the Park for one night.

The value of tourist spending was calculated by multiplying the number of tourist nights by average spend per night.

Results

The total number of domestic visitors to the Drakensberg tourism destination region is 562 520, of which approximately 200 000 to 250 000 enter the Park (EKZNW unpublished figures; TKZN 2009). The total number of foreign visitors to the Drakensberg region is 144 841 (TKZN 2009), and it is likely that a large percentage would have visited the World Heritage Site.

Based on the tourist numbers, length of stay and average daily spend, it is calculated that local visitors spend approximately R63 million per year directly associated with the presence of the Park, whilst foreign visitors spend some R145 million per year. **Visitors to the Park could thus spend at least R208 million per year in the local and national economy, conservatively speaking** (2009 values).

It should be noted that prior to the Drakensberg being declared a World Heritage Site in 2000 only 20% of KZN's foreign tourists visited this mountain range, whereas after World Heritage Site listing it is now in the order of 30% (Seymour 2008). The international status has therefore resulted in an increase in tourism spending in the region, and the maintenance or growth thereof is therefore directly linked to the site retaining its international status, which in turn is directly linked to EKZNW's ability to effectively manage the site, this in turn linked to adequate resources being provided to EKZNW to conduct critical management activities.

Discussion & Conclusions

It is clear that the UDPWHS offers services to society that are of significant value; converting this to monetary values through different accepted economic methods gives a better indication of the magnitude of these values, which are summarised in Table 3.

Table 3: Summary of some economic values (water, carbon, rock art and tourism) for the UDPWHS (Rands)

Service	Minimum value	Maximum value
Water (asset value)	47,522,800	4,158,154,956
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It is clear that the magnitude of the value of the Park far exceeds the input management costs. To illustrate this, the UDPWHS costs the provincial government approximately R20 Million per annum (EKZNW 2005). Taking the value of one service, that of water production, the state is investing only 1.86% of the asset value in maintenance/management of that asset (c. R20Million vs. c. R1Billion asset value). Under some assumptions that investment is as low as 0.48% (c. R20Million vs. R4.1Billion asset value). Good business practice dictates that an organisation should invest at least 10% of the asset value per annum in maintenance of the asset. It is therefore clear that KZN province is significantly under-investing in maintenance of a key strategic asset. Some of the implications of the under-investment are already becoming apparent, and include increases in alien plant infestation (resulting in lower water production), uncontrolled soil erosion (leading to reduction in water quality), collapsing boundary fencing (resulting in incursion of livestock and accelerated erosion), and fire damage to rock art (resulting in a loss of cultural heritage). All of these ultimately have the potential to result in the loss of World Heritage Status, and ultimately to loss of the economic value provided to KZN by the World Heritage status.

Whilst appreciating the economic values that have been calculated, it is important to note that the value of only two ecosystem services have been quantified vis. water supply regulation and soil carbon. There are another 33 ecosystem services that have been identified, but not valued, for the Park (Mander et al. 2009). For example:

- The Drakensberg is used for marketing South Africa at the global level e.g. iconic status of the Amphitheatre
- There are a large number of users downstream (2.5 million in Sisonke and uThukela) of the protected area who benefit significantly from soil stability, water supply regulation, water distribution, disaster damage control, moderating climate extremes and waste assimilation. These services also benefit households and municipalities downstream through generating savings on water infrastructure costs.
- There are between 400,000 and 150,000 users immediately adjacent to the UDPWHS (in Sisonke and uThukela) who benefit in various ways from

the protected area. For example, fire damage control, disease control in stock, flood attenuation, pollination and soil formation, are all important local benefits.

- There are between 200,000 and 300,000 people who benefit by either visiting the protected area or by looking onto the mountains from adjacent areas.
- There are also a number of local beneficiaries for services, such as sacred sites, medicinal plants, ornamental plants, seed dispersal and genetic vigour.

As many of the benefits associated with ecosystem preservation (ecosystem services) are undervalued by the market, market information will lead governments to socially inefficient land use decisions. Correcting for market and government failure in the Drakensberg region requires a two stage process: firstly, accurate information needs to be derived regarding the value of the water supply regulation ecosystem service; secondly, policies need be designed such that continued delivery of the service is supported, and certainly not compromised. The purpose of economic valuation is to provide accurate information regarding ecosystem values.

The UDPWHS therefore supplies a wide range of public goods and services, promoting social and economic development both directly and indirectly to the private and public sector. Importantly, as the scarcity of these ecosystem services supplied increases with land conversion, unsustainable use and climate change the value will increase, generating not only a greater demand but also creating opportunities to sell these services. Water security and carbon sequestration are the two new services on the market which can be traded successfully, and these emerging tradable services could constitute a new revenue stream for protected areas (Knowles et al. 2008; Mander et al. 2009).

Acknowledgements

An earlier draft of this report benefited significantly from comments provided by Steve McKean.

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… the emphasis on valuing ecosystems and their services is probably misplaced. Economics cannot estimate the importance of natural environments to society: only biology can do that. The role of economics is to help design institutions that will provide incentives for the conservation of important natural systems and will mediate human impacts on the biosphere so that these are sustainable.

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