Chapter 10

The Economic Value of Elephants

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Introduction

Elephants, as megaherbivores, play a huge role within any landscape where they occur. They are habitat engineers. As charismatic species they also evokes emotions among people like few others. They are magnificent animals. And, as keystone species, they contribute significantly to the economic value of conservation areas. They are therefore also value generators. In this context we first consider the range of relevant economic values, using the Total Economic Value approach in a generic sense, and then apply this framework to identify the specific factors that determine the economic value of elephants in South Africa. Thereafter we summarize both regional (southern Africa) and international studies that consider the economic value of elephants. We conclude with an assessment of the state of knowledge on elephants' contribution to the economic value of elephant-containing ecosystems and the economy as a whole.

This study borrows heavily from studies concerning the economic value of elephants done in Botswana, Namibia, and Zimbabwe since similar studies in South Africa could not be located. To date, published studies in South Africa focussed either on the cost of the individual elephant management options - which is a subject treated in the relevant management chapters of this book - or else investigations of the value of tourism. Unfortunately, the specific contribution of elephants to the value of tourism was not isolated in these studies. This is a limitation, but, as will be seen by the discussion below, there is much to be learned from the existing studies carried out elsewhere.

Economic value: Some background discussion

Adam Smith, the 'father of modern economics', distinguishes between two types of economic values, namely exchange values, and use values. He clarifies as follows (Smith, 1997:131):

> *The word VALUE, . . . has two different meanings, and sometimes express the utility of some particular object, and sometimes the power or purchasing other goods which the possession of that object conveys. The one may be called "value in use"; the other, "value in exchange". The things which have the greatest value in use have frequently little or no value in exchange; and, on the contrary, those which have the greatest value in exchange have frequently little or no value in use.*

He explains the distinction between exchange and use value by referring to the well-known water-diamond paradox. Nothing is more useful than water, yet it has almost no exchange value. In contrast, diamonds have relatively little *real* use, but have extremely high exchange values. Exchange values are easy to observe. They are the market values of a product, good or service. Use values, however, are not observed. If care is not taken one could easily ignore these use values during decision-making processes. The economic valuation of ecosystem goods and services is an attempt to mitigate the impact and affect either of the absence of markets or the wrong signals markets send by estimating the value of natural capital in terms of what these resources do and/or contribute to society. Some are opposed to the quantification of the value of natural resources (McCauley, 2006), but most of

these antagonists are ignorant about the way economists distinguish between the environment's use value and exchange value. Ecological economists are fully aware of the fact that it might not always be possible, or even necessary or desirable, to estimate the use value of a resource - especially when dealing with so-called *critical* natural capital (Ekins *et al.*, 2003; Farley and Gaddis, 2007; Blignaut *et al.*, 2007). Yet, by estimating the values that are deemed appropriate, economists acknowledge the fact that environmental values exist and that they contribute meaningfully and significantly to social welfare.

Figure 10.1 provides a breakdown of the suite of environmental values by primarily distinguishing between the primary and secondary value of the environment. Primary values – values without an economic purpose – are also called intrinsic values and reflect the non-demand values of ecosystems. In some instances, primary values could also be considered as the value of life itself. Economists do not place a monetary value on these, but often take cognisance thereof in a qualitative sense. Ecosystems' secondary values, also called the Total Economic Value (TEV) of ecosystems, comprise direct, indirect, option, existence, and bequest values – see Box 10.1 for a discussion as to the different components of TEV.

Box 10.1: Total Economic Value (TEV): A description

- Direct use values often are exchange values since markets can exist for them. The estimation thereof is conceptually straightforward, but not necessarily easy. The fact that markets do (or can) exist does not imply that they are functioning well. Market imperfections such as legislations, trade-bans, and spatial and temporal differences between resources, can distort such a market and hence the market outcome. Direct use values can be sub-categorised as:

  o consumptive use values (e.g., elephant meat, ivory, trophy hunting); and
  o non-consumptive use values (e.g., game-viewing, elephant rides, etc.).

- Indirect use values correspond closely to the value of ecosystem functions (e.g., watershed protection, carbon sequestration, nutrient recycling). In the past these values tended to be use values but this is changing, with the advent of the carbon and water markets, and they are increasingly becoming exchange values. Biodiversity markets, however, are not well developed yet and the role an individual species, such as an elephant, plays within an ecosystem is also not isolated within this market. This is not to imply that this cannot change in future. Much discussion is underway to develop a biodiversity market of which both South Africa and all of southern Africa could be beneficiaries. Indirect use values are, however, not just positive. Individual species, such as an invasive alien plant, can have a negative impact on the social and economic value, and the ecological functioning of an ecosystem in general, and likewise the over-population of an endemic species such as an elephant can be globally negative;

- Option value is an expression of an individual's preference not to make use of a resource today because he/she prefers to retain the option to use the resource in future and, therefore, is willing to pay for today's conservation to retain the option for any possible future use;

- Bequest value is a measure an individual's willingness-to-pay to ensure that an environmental resource is preserved for the benefit of his/her descendants. Bequest values are non-use values for the current generation, but a potential future use or non-use value for their descendants; and

- Existence value measures the willingness to pay for the preservation of the environment that is not related to either current or optional use, thereby being the only true 'non-use' value. Existence values are based on the concept of the environment [or an individual species] being there. In some cases, bequest values are treated as part of existence values as it is often difficult to differentiate between the two on an empirical level.

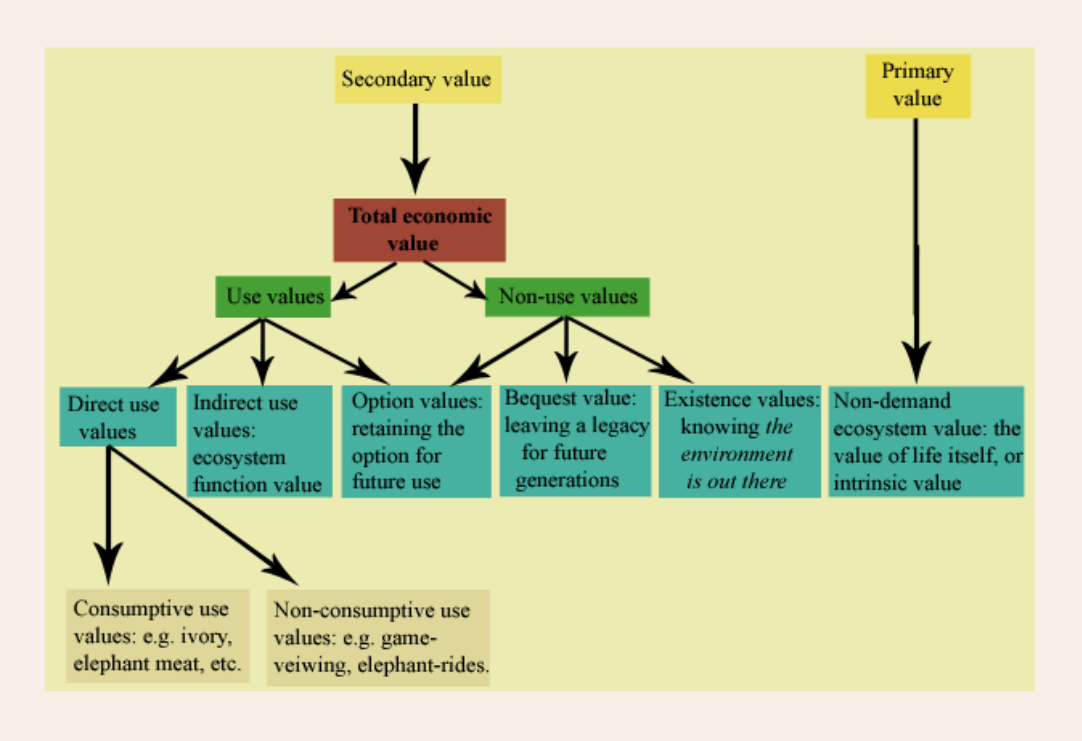

Figure 10.1: Values for the environment. Source: Adapted from Turner, R.K., Pearce, D. and Bateman, I. 1994. Environmental Economics. An Elementary Introduction. New York: Harvester Wheatsheaf.

In the next section we discuss this suite of values with specific reference to elephants.

The economic factors determining the Total Economic Value (TEV) of elephants

The TEV of elephants does not constitute a mere summing up of all the animal's use and non-use values. There is conflict, even 'rivalry', among some of the categories. For example, the direct consumptive use of an elephant for its ivory excludes the possibility to enjoy any non-consumptive or non-use value from that individual animal. The direct consumptive use of the individual, however, does not - at least theoretically -, exclude any non-consumptive or non-use value of the population as a whole. In some cases the direct consumptive use of a resource could have a negative impact on non-use values depending on how people act and react to such direct use. This is due to the fact that non-use values are driven by

perceptions and heavily influenced by specific contexts, which can change over time and in response to events. Neither are these values easily transferable from one setting to another.

The impact of elephants on their surroundings can also lead to a decline in the total economic value of the return on the ecosystem in general since, if not managed properly, an overpopulation of elephants often leads to environmental degradation. Such degradation could lead to a loss in ecosystem function (indirect use value), which not only implies a loss in ecosystem productivity and resilience, but also the need for ecosystem restoration. The utilisation of field crops by elephants that escape from conservation areas and the ensuing challenges between humans and elephants are a direct cost to the affected human community. But this cost is not reflected in, for example, the value an international tourist derives from viewing elephants in the park or protected area where the damage-causing individual lives. This implies that space and context matter when considering economic valuation. Additionally, partial analyses may skew perception of the total economic value. For example, should a study only focus on one aspect of the total economic value, say its non-consumptive use value, but not consider any other value - such as the loss in its plausible consumptive use values or its nuisance value -, this can lead to wrong conclusions. It is best to consider the suite of values as a package and, from an economic vantage point, optimise the suite of them rather than any one individual component. This implies the need for systems thinking and adaptive management, well informed by good data.

Lastly, two entrenched problems, in all forms of economic valuation, are the issues of time and income difference. As for time, studies have to make adequate provision for both the time preference of money – which usually depreciates over time – and the change in value of ecosystems goods and services – which usually increases over time. As for income differences, often communities adjacent to conservation areas are poor, while visitors to the park are affluent. These two constituencies tend to value and evaluate a resource such as elephants quite differently because of their different perspectives, and their different relationships with, or uses of, elephants. One has to consider and seek to optimise the value of the system as a whole and not just that of an individual value.

Having discussed the range of difficulties and possible anomalies one is facing when considering TEV, let's turn to some concrete examples of each of the different TEV categories. As will be indicated in the next section, most of the economic valuation studies done in the past focussed on the direct consumptive use value of elephants. Since the African elephant has been listed in Appendix I of CITES' list of endangered species in 1989, and this became effective in 1990, the direct consumptive use of elephants has been reduced dramatically and is currently effectively zero. But it remains a focal point and is likely to become more important over time. This is due to the ongoing debate within CITES, especially between China and Japan and the other Far Eastern countries, and the West (mainly Europe and the Unites States). The Far Eastern countries view the CITES trade ban as an unnecessary economic evil and would like to see it annulled. By and large, the countries in southern Africa also support the removal of the trade ban, but for completely different reasons. They are concerned with the overpopulation of elephants and are looking for means to manage these megaherbivores and vegetation bashers. Together, these countries form an anti-ban lobby canvassing for the lifting of the ban, either in full or in part. Such a lifting of the ban will lead a new series of economic drivers influencing elephant conservation management. Such a change would also affect other, non-consumptive use factors, which determine the total economic value of elephants, as is listed in Box 2.

After considering the range of economic values, the next section provides a summary of the relevant quantitative estimates by first looking at studies investigating the economic value of elephants in southern Africa.

Box 10.2: Non-consumptive use values of elephants

- Direct (non-consumptive) use: Within the tourism industry, elephants are important draw cards or attractions. The benefits of elephant within the ecosystem from a tourism perspective includes direct income to households through employment, ownership, or equity in tourism-linked businesses, as well as foreign exchange earnings for the government, and government income through taxation of individual earnings, sales taxes and corporate taxes. It is, however, costly and a management intensive exercise to host elephants. Elephant tourism options include either low numbers / high paying options (no self drive; overnight lodges) or high numbers / low budget options (self drive and camping or self-catering lodges). Elephant-related tourism expenditure is therefore a good indicator of people's willingness to pay for them.

- Indirect use: Elephants are a keystone species in any biome where they occur and they play an important biological role in ecosystem functioning, ensuring the survival and continued evolution of many species. These values are generally not measured and can go two ways. One could value the indirect value of elephants either as an umbrella species, and therefore incorporating a range of other values in their value as well, or, individually by considering its role in the ecosystem. This could be positive, as an important habitat engineer, or negative, as a megaherbivore whose actions can lead to ecosystem degradation requiring restoration and intensive management. This is especially the case when population densities become too large.

- Non-use values: There is an ongoing global concern for the continued existence of elephants. This concern is expressed mainly in the form of donations focussing on the protection of the elephant. In Kenya, for example, the elephant conservation industry is largely dependent on this form of money transfer for its continued survival. How sustainable and efficient it is, however, can, and is being questioned (Norton-Griffith 2007). Wildlife policies create the enabling environment for wildlife conservation, also for elephants, which, if designed appropriately, will be conducive to both conservation and the development of economic opportunities through markets. Market mechanisms can be developed to harness the non-use values of elephants in conjunction with their direct and indirect use values.

(Based on Geach, 1997 and 2002.)

Economic value of elephants in southern Africa: a literature overview

Several studies estimating the economic value of elephants have been undertaken in Botswana, Namibia, and Zimbabwe. Nearly all of this work focused on direct use values associated with the elephant. Policy in all three countries is aimed at promoting generation of income and employment from wildlife, and research has thus been focused primarily on the value of elephant utilisation.

Prior to the Appendix I CITES listing of the African elephant, Child & Child (1986) and Child & White (1988) documented the financial values associated with elephant culling, which was being undertaken at that time in Zimbabwe to control the growing numbers of elephants in national parks. They showed that the culling programme, operated by a special unit within government, was profitable. Sales of ivory and dry salted hides exceeded the costs of low-budget culling of matriarchal herds in the national parks. In addition, low quality dried meat was provided

cheaply to neighbouring communities in an attempt to engender local support for elephant conservation by offsetting the need for poaching for bushmeat. At the time, numbers culled varied between 800 and 1,500 per annum.

In 1989 the Botswana Department of Wildlife and National Parks undertook an analysis of the options for utilisation of its rapidly growing and very large northern elephant population. At the time, the only use of elephants was non-consumptive, as part of the general wildlife viewing experience. Hunting was banned and culling had not been introduced. The Appendix II listing for elephant at the time would have allowed reintroduction of elephant hunting and the introduction of a culling programme. Soon after that, initiatives among the CITES parties were made to have elephants listed in Appendix I. This was enacted in 1990, effectively closing all trade among CITES parties in consumptive products for the species. Botswana, which was against the listing, undertook a study to compare the economic values of the options for use of its elephant resource. Barnes (1990) estimated and documented the contribution that use of elephants for wildlife viewing tourism, trophy-hunting tourism, hunting by citizens, and culling, could make to Botswana's national economy. This was followed with analyses for 1990 and 1992 of the effects that the international policy environment had on these values (Barnes, 1992 & 1996a). The studies involved detailed financial and economic, budget/cost-benefit models of wildlife viewing activities in elephant areas, trophy hunting, and elephant culling as developed by Barnes (1998). These models were based on empirical evidence from users including data from the elephant use activities in Zimbabwe. The proportions of value attributable specifically to elephants were estimated as representing 41% of wildlife viewing value, and 37% of trophy hunting value. The models provided measures of the private profitability for the investor, as well as the net contribution of the activity to the national income. The net present value of various combinations of this income over 15 years, taking into account policy and plans for development of utilisation in the wildlife sector, were estimated, as summarised in Table 10.1 (see Barnes, 1996a and 1998 for the details on the research methods employed).

As indicated in Table 10.1, among the list of options for elephant use in Botswana in 1989 the combination with the highest value is Scenario 6 that contained all

possible uses except hunting by citizens. To a large extent, elephant-viewing tourism, trophy hunting, and elephant culling were complementary spatially, allowing the highest values to be generated. The introduction of trophy hunting and culling of elephant was assumed to have a moderate effect on the values of elephant viewing through disturbance. In 1990, after the Appendix I listing, trophy hunting under quota was still permitted, and the option of culling was still a possibility with some products marketed domestically and to non-CITES parties. Since 1990, culling could therefore add very little to the economic use value of Botswana's elephants, implying that the CITES listing effectively reduced the use value of elephants by some 47%, as represented by the decline in its value from P293million in 1989 to P155million (Table 10.1).

Table 10.1: Present values of increases in Botswana' gross national income[a], over fifteen years, attributable to options for elephant management (1989 and 1990 analyses) (Source: Barnes 1996a; 1998)

Senario (option)	15 Yeat Present Value @ 6%[a] (Pula `000, 000: 1989)[b]	
	June (1989)	Octobr (1990)
Viewing only with no consumptive uses	108.9	108.9
Viewing with trophy hunting only	153.2	153.2
Viewing with citizen hunting only	130.7	-
Viewing with culling only	248.7	110.5
Viewing, trophy and citizen hunting and culling	282.3	-
Viewing, trophy hunting and culling	293.5	155.3

[a] Cumulative contribution to gross national income by year 15, after discounting at 6% per annum and after partial shadow pricing

[b] In 1989 Pula 1.00 was equal to Rand 1.32, and US$ 0.51; Pula inflation factor from 1989 to 2007 is 3.50

A second analysis carried out two years later, in 1992, showed similar results (Barnes, 1996a). Culling, with the markets restricted to domestic SACIM, or non-CITES signatories, was not able to generate additional national income. Elephant trophy hunting could, however, increase the value added by between 36% and 58%, depending on how much it disturbed elephant viewing activities. At the same time

a cost-benefit analysis was conducted (Barnes, 1996a), comparing predicted national income streams generated from different possible use options with predicted government expenditure streams for elephant conservation. Future net income streams with management costs increasing to P242 per km^2 over 15 years generated positive returns in national income for all options. When costs were increased to P510 per km^2 (i.e. US$ 246 per km^2 after taking inflation and exchange rate fluctuations into account), as might occur with a surge in poaching, the inclusion of elephant trophy hunting was an important factor in ensuring a positive return for investment in elephant conservation. Table 10.2 shows the results of this analysis.

Table 10.3 shows the breakdown of value in terms of potential contribution to national income for all the different elephant products when all uses were included under conditions prevailing in 1989, 1990 and 1992. The salient point is that the culling values, which would have amounted collectively to 40% of the total elephant use value in 1989, were reduced to negligible levels after that. The analysis of Barnes (1996a, 1998) provided evidence of the negative impact of the Appendix 1 listing on the economic viability of elephant conservation in Botswana. Combating elephant poaching for ivory was the prime motivation for the Appendix I listing, but this eliminated all culling values. It is noteworthy that values attributable to ivory (ivory sales and ivory carving in Table 10.3) made up only 42% of the total value of culling which was lost with the listing. Southern African countries have been trying to re-establish ivory markets within the CITES framework, but even if this is successful, it is unlikely that the 1989 markets for other elephant culling products, such as hides, could be revived. Culling as a use option appears to have irreversibly lost the economic viability it had in 1989. In addition, culling as an activity has increasingly faced opposition from animal rights lobbies. Recent elephant utilisation policy in Botswana has allowed for a combination of elephant viewing and elephant trophy hunting only, with culling retained as a possible option for management purposes only. Since loss of culling value has resulted from attempts to conserve elephant, an argument could be made for compensation through the capture and transfer to Botswana of international non-use values for elephant.

Table 10.2: Effect of different scenarios for government expenditure on elephant management on economic net present value[a] of different options for elephant utilisation in Botswana (1992 analysis) Sources: Barnes, 1996a; 1998.

Expenditure category [c]	15 year Net Present Value @ 6%[a] (P '000,000, 1992)[b] Utilisation option			
	Viewing only with no consumptive uses	Viewing with trophy hunting only	Viewing with citizen hunting only	Viewing with culling only
Base case (costs rising from P16 to P242 per sq. km. over 15 years)	123.5	181.5	122.6	181.2
Slow increase (costs rising from P16 to P510 per sq. km. over 15 years)	84.0	142.0	83.2	141.8
Medium increase (costs rising from P16 to P510 per sq. km. in first 10 years)	-1.5	56.5	-2.3	56.3
Fast increase (costs rising from P16to P510 per sq. km. in first 5 years)	-20.0	37.8	-20.9	37.6

[a] Value added over 15 years to national income, net of government expenditures, after discounting at 6% and after shadow pricing (April, 1992)

[b] In 1992 Pula 1.00 was equal to Rand 1.34, and US$ 0.47; Pula inflation factor from 1989 to 2007 is 3.02

[c] Different patterns of increase to a stable maximum for government expenditure on elephant management over the northern range (49,000 square kilometres)

Work on the economics of consumptive tourism (i.e., recreational hunting) in Namibia and Botswana (Novelli *et al.*, 2006) has shown that trophy hunting occupies a spatial niche, which is complementary to and does not oppose or displace wildlife viewing tourism. The inclusion of elephants in trophy hunting quotas adds significant value to trophy hunting tourism. In addition to the elephant trophy fees, income from daily hunter fees is enhanced by the inclusion of a high value elephant in the hunting bag. Using data from a northern Botswana trophy hunting enterprise model (Turpie *et al.*, 2006), and comparing values from trophy hunting in Botswana where elephants are important (ULG Northumbrian, 2001), and Namibia, where

open plain game is important (Novelli *et al.*, 2006), it was possible to impute a proportion of hunting income to elephants. Based on these calculations we estimate that some 44% of the income from an elephant-inclusive hunting experience in northern Botswana is attributable to elephants.

Table 10.3: Proportional contributions of different products to the economic present values of elephant use[a] in Botswana in the 1989, 1st 1990 and 1992 analyses (Sources: Barnes, 1996a; 1998.)

	Year of analysis		
	1989	1990	1992
Total present value[b] (Pula million, 1989)[c]	293.5	155.3	133.0
Use category			
Tourism - viewing	44.2%	70.1%	71.3%
Tourism - trophy hunting	16.4%	26.0%	26.5%
Culling - raw ivory	8.7 %	2.3 %	-
Culling - ivory carving	7.9%	-	-
Culling - fresh or dried meat[d]	0.8%	1.2%	0.8%
Culling - meat processing[e]	11.6%	-	0.3%
Culling - dry salted hides	6.6 %	-	0.6%
Culling - hide tanning	3.7%	-	0.2%
Culling - live sale (calves)[f]	0.2%	0.4%	0.3%
Total	**100.0 %**	**100.0 %**	**100.0%**

[a] Management option 6, which included viewing, trophy hunting and culling for each year of analysis

[b] Present values for June 1989 and October 1990, and net present value for April 1992; all at 1989 prices

[c] In 1989 Pula 1.00 was equal to Rand 1.32, and US$ 0.51; Pula inflation factor from 1989 to 2007 is 3.50\

[d] Carcass value after field recovery and field dressing

[e] Including (in 1989) use of meat as feed in crocodile breeding and rearing for production of skins and meat, and (in 1992) production of carcass meal

[f] Sale of calves between six months and one year old

No such comparative studies for South Africa have been conducted, but the live sale of elephants and the occasional hunting thereof on private land is permitted and the

values thereof are known. Table 10.4 provides an overview of the average prices and number of trades over the past three years for various categories of animals. The trade in the number of live animals is restricted since all conservation areas have reached their respective carrying capacities and trades are restricted to private game farms. The number of animals available for hunting is restricted by the fact that only animals from private game farms are eligible. The price per elephant, whether as a live sale or for a hunt, is very high and is due to the restricted nature of the market. It is therefore not possible to derive a total market value for all elephants in South Africa from these numbers.

Table 10.4: Average prices and number of elephants traded in South Africa per year over the period 2005 - 2007* (Source: Dr. Douw Grobler, CatchCo, Personal communication.)

Live sales			Hunts		
Category	Price per animal (R)	Number	Category (kg)**	Price per animal (R)	Number
Trained animals	575 000 - 1 100 000		15 - 20	290 000	10
Juveniles	50 000 - 5000 000		20 - 25	325 000	7
Cows plus family	15 000	150	30 - 35	430 000	2 - 3
Bulls: approx. 20 kg**	75 000	30	35+	500 000	2
Bulls: approx. 30 kg**	100 000	20			

* Numbers quoted in Rands, but most trading takes place in US$s and an exchange rate of R7,2/$ has been used.

** Weight of tusks.

As far as ivory sales in South Africa are concerned, the parties at the 12th Conference of Parties (CoP) to CITES in 2002 agreed to a one-off sale of 30 tons of ivory originating from the Kruger National Park. The prospective buyers had to register with the CITES Secretariat fulfilling various requirements as lay down by

the Conference. Only Japan and China indicated an interest in buying the ivory. To date (September 2007) only Japan has been verified as trading partner. China will most probably be verified as a trading partner during the Standing Committee meeting scheduled for July 2008. CITES approved of the trade taking place at the CITES Standing Committee meeting in the Netherlands in June 2007. A further one-off sale has been approved by the 13th CoP of CITES which took place also in June 2007 which includes legally obtained ivory stock from South Africa, registered with the CITES Secretariat by 31 January 2007. Before the sale can take place, the ivory must be verified by the CITES Secretariat to be eligible for sale within the CITES framework and agreement.

Now we must ask: can people in areas adjacent to and living in elephant containing ecosystems benefit in any way from the presence of the elephants? One mechanism through which elephants can benefit local communities is through community-based natural resource management (CBNRM) programmes. CBNRM programmes have been in the process of development in nearly all southern African countries since the 1980s and they aim to partially devolve property rights over wildlife to communities on communal land, and are well developed in Namibia, Zimbabwe, and Botswana. Wildlife use, involving elephants for both wildlife viewing and trophy hunting, is commonly associated with these programmes. CBNRM in Namibia (Libanda and Blignaut, 2007), and in Botswana, involve both non-consumptive and consumptive tourism, but in Zimbabwe's CAMPFIRE programme, over 80% of income derives from trophy hunting in the 1990s was dominated by elephant values (Bond, 1994 & 1999), and this figure seems to have risen above 90% in recent years (Muchapondwa, 2003).

Elephants are therefore quite important as generators of income both nationally and for local communities in Botswana, Namibia, and Zimbabwe. However, they also generate costs in the form of damage to crops and infrastructure wherever they occur outside of fenced conservation areas. Sutton (2001) and Sutton *et al.* (2004) conducted a detailed household survey to measure the costs and benefits of living with elephants in the Caprivi Region of Namibia. Sutton determined that in the agro-pastoral system, which predominates in this region, elephants generate fewer damage costs than other wildlife, and that livestock actually cause more crop

damage than all wildlife put together. Nevertheless, elephants still manage to reduce crop yields significantly. Jones and Barnes (2007) used crop damage data in crop enterprise models to show that average crop losses due to elephants, reduced net profits for small-scale crop growers by some 30%. Crop damage varies spatially, and in areas where it is the highest (some two or three times the average) crop profits can be eliminated altogether. Barnes (2006) used a similar crop enterprise approach to estimate the value of crop losses due to elephant in the Okavango Delta area of Botswana. Here, damage levels were generally higher, and average small-scale, rainfed crop production profits were reduced by some 75%, and even entirely eliminated in some cases.

Of importance here is the degree to which elephant damage costs incurred by communities can be offset by the benefits they derive from use of elephants through CBNRM. Models of community investments in CBNRM, developed by Barnes *et al.* (2001 & 2002) were used to compare the wildlife crop damage costs with the utilisation benefits incurred by communities in both of the Caprivi and Okavango delta study sites. Table 10.5 and Figure 10.2 (derived from Barnes 2006) show the results for a typical CBNRM investment in the Okavango delta. The impacts of various crop damage levels (based on average figures) on the profits made by the community trust, the community members as a group, and the contribution made by the investment to the gross and net national income, were measured. Generally, benefits outweighed costs for all measures. In the case of the community trust, losses were only incurred when damage costs of three times the average levels were sustained over time. Jones and Barnes' (2007) results for the Caprivi Strip, Namibia, also established that CBNRM benefits generally outweighed crop damage costs. Various policy options are available to address elephant and wildlife damage costs. These studies suggested that human-elephant conflicts could be internalised with CBNRM programmes.

Table 10.5: Impact of elephant crop damage costs on the measures of private and economic viability for a model CBNRM community trust investment in the Okavango Delta, Botswana (Pula/annum, 2006)[a] (Source: Barnes, 2006.)

	Elephant crop damage level		
	Basic damage cost	2 x damage cost	3 x damage cost
Trust profit	604 200	333 600	- 155 900
Community net benefit	1 199 400	928 800	439 300
Gross output	2 578 300	2 578 300	2 578 300
Gross national income (GNI)	2 002 900	1 777 600	1 349 800
Net national income (NNI)	1 894 400	1 669 100	1 241 400

[a] In 2006 Pula 1.00 was equal to Rand 1.14, and US$ 0.16; Pula inflation factor from 2006-2007 is 1.06

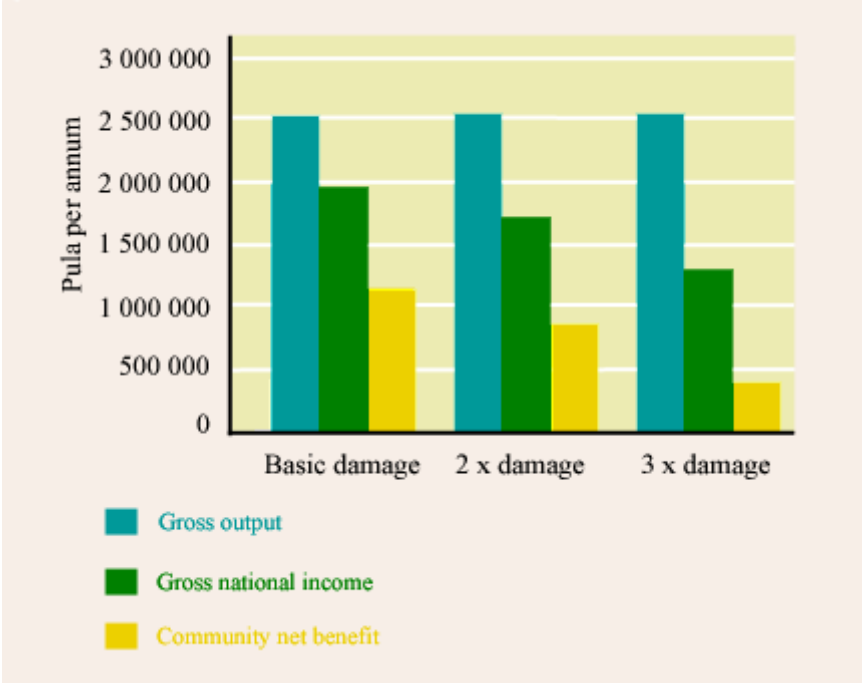

Figure 10.2: Impact of elephant crop damage costs on the economic gross output, the contribution to the gross national income, and the private community net benefits for a model CBNRM community trust investment in the Okavango Delta, Botswana (Pula/annum: 2006) (Source: Barnes, 2006.)

While it appears that in southern Africa rural people at the community level can derive positive net benefits from wildlife, do they actually derive direct financial gains from it? Libanda and Blignaut (2007) found that in Namibia households do

generally benefit significantly from CBNRM and that sufficient institutional mechanisms are in place to ensure broad-based support for the programme, as indicated by the rapid growth of the CBNRM programme from its inception in 1996, to the end of 2006, when it included 50 CBNRM areas and covered an area of 118,705 km^2. The area under CBNRM management comprises 15% of the land surface of Namibia and is adding to the 16,5% of the land surface area that is already formally protected. CBNRM areas already host 37% of Namibia's rural population and a further 31 conservancies are in various stages of development, clearly indicating the widespread interest in, and support for, the programme.

In contrast, this success of CBNRM is not unequivocally shared in Zimbabwe. Muchapondwa (2003) and Muchapondwa *et al.* (2003) conducted contingent valuation studies in Mudzi District, a CAMPFIRE district since 1992, where households' willingness to pay for the preservation of elephant was measured. Some 570 households, randomly selected from within two similar wards in Mudzi District were surveyed, and, along with the willingness to pay bids, variables such as household size and income, sex, age, and education of household head, distance from an elephant reserve, size of intruding elephant herds, existence of mitigation, support for government conservation, participation in agriculture, and labour spent on mitigation were tested. The studies found that 34% of households were willing to pay for elephant preservation, with a median willingness to pay (WTP) of Z$300 or US$5.45. This was 3.87% of median annual income. However, 62% of households had a negative willingness to pay for elephant - they were willing to pay to have elephants removed from their area, with a median WTP of Z$98 or US$1.78. This was 1.27% of median annual income. The results indicated that the community as a whole had a net positive willingness to pay for elephant preservation, but that the majority of community members did not support elephant preservation. This suggested that any net benefits that the community might have derived from CBNRM must not have been reaching many households. Muchapondwa *et al.* (2003) recommended external transfers to households in Mudzi to increase incentives for elephant conservation. The willingness to pay values estimated by Muchapondwa *et al.* (2003) can be said to represent non-use values, namely, any or all of option, bequest, or existence values. In the CBNRM

context, they are likely to be made up largely of option values. Apart from these findings on local non-use values, no other studies appear to have been carried out.

The economic value of elephants: Other examples

While we have emphasised the studies estimating the economic value of elephants in southern Africa thus far, a large number of other, non-regional, studies have been conducted as well, a selection of which is summarised in Table 10.6. It must be noted that values derived in these studies are not always comparable, either between themselves or with the studies listed above since different methods and measures are used.

Using an open-ended stated preference technique, Vredin (1997) estimated the median Swedish household's willingness-to-pay (WTP) for the preservation of African elephants, which is an attempt to capture the non-use values of elephants. With a resulting median value of SEK100 (= $14.92) per household for the year 1996, it was estimated that the aggregated WTP of the Swedish population for the preservation of the African fauna and flora (using the African elephant as indicator) is SEK383 million (=$53.7 million). The main motives stated were: existence value (30% of valid observations), care for future generations (28% - bequest values) and own experiences (18% - option values). This WTP is sensitive to changing income, as follows: a 1% increase in income would lead to a 0.3% increase in WTP (Hokby & Soderqvist, 2003). When taking this income elasticity into account as well as an average growth rate of 2.8%, and changes in population since 1996, but with all other things being equal, aggregated WTP in 2006 has increased to SEK 420 million ($57 million). At average 2006 exchange rates, this amounts to $14.73 per household per year. Currently, there are between 470 000 to 690 000 African elephants in the wild (WWF, undated). Assuming 500 000 elephants and extrapolating to all 150 million European and US households (see Bulte *et al.*, 2006), this amounts to an indicative total WTP of $2.2 billion per annum, or $4,420 per elephant per annum. These numbers are, however, only indicative of the fact that the WTP for elephant conservation are potentially significant and cannot be used in absolute terms since they are based on too many assumptions.

Table 10.6: Valuation studies on African elephants (excluding studies from southern Africa)

What has been valued	Valuation technique	Source	Values	Remarks
WTP of Swedes to preserve the population of African elephant	- Open Ended Contingent Valuation Method - Linear aggregation	Vredin (1997) Hokby & Soderqvist (2003)	1996: $53.7 million for all Swedes Median: SEK 100 per household	1500 Swedish residents in age group 18-75 Income elasticity of WTP for African elephants is estimated at 0.3
The cost of preventing a decline of elephants from severe commercial poaching for their ivory	Defensive Expenditure Method (Cost of protection)	Leader-Williams (1994)	1981: $215 per km2 (adjusted to 1994 values: $340 per km2)	The relationship between spending and success in protecting elephants was significant but only explained 32% of the variance.
Tourism value of elephants in Kenya	Travel Costs	Brown and Henry (1989)	1989: $25 – 30 million pa $1 562 per elephant	Estimating consumer surplus from European and North American visitors
Conservation of 650 elephants in Amboseli NP	Marginal cost of PES scheme to conserve elephants	Van Kooten and Bulte (2000) Bulte *et al.* (2006)	$10 per acre per year ($2 470 per km2) or $175 per elephant per year; equal to an estimated minimum of $0.60c per European and US household per year for all African elephants	*Current estimates of the African elephant population amount to some 500 000 head. Assuming a minimum benchmark cost of $175 per elephant per year, the total benefits of elephant conservation should amount to $87.5×106 per year. Dividing by the number of households (150×106) this amounts to $0.60 per household per year.* (Bulte *et al.* 2006).
Value of ivory exports from Africa	Market price	Ivory Trade Review Group (as quoted http://www.american.edu/ted/elephant.htm) Cobb (1989)	1979: $36.89 million; 1987: $19.18 million 1979-1987: >$500million	Estimated 1.3 million elephants killed for their tusks during 1970s and 1980s
Ivory value	Market price	Vredin (1995)	1987: $2 734 per elephant	
Trophy value	Market price	Vredin (1995)	1989: $2 366 per elephant	
Relocation of elephants from KNP to Shamwari Game Reserve	Market price	Wilderness Conservancy (http://www.wilderness conservancy.org/projects/ongoing.html)	$2 850 per elephant	

The estimated total gross tourism viewing value of elephants, in particular, was estimated at between $25 and $30 million in Kenya in 1989 (Brown & Henry, 1989). This value was based on the travel costs of European and North American visitors and their stated purpose of travel. With an estimated 16 000 elephants in Kenya in 1989 (Ivory Trade Review Group, as quoted http://www.american.edu/ted/elephant.htm), and using a low value of $25 million per annum, that amounts to a mean WTP of $1,562 per elephant in Kenya. Assuming declining travel costs and rising income over time this figure can be used as indicative for current values, but with low levels of confidence. Assuming that only three-quarters of Africa's elephants (375,000) are accessible to tourism this provides an indicative value of $585 million or $3.91 per European and US household per year. This is probably a low estimate, as up to 90% of African elephants occur in southern and eastern Africa (Blanc *et al.*, 2007), both of which

regions are readily accessible to international tourism. Despite the low levels of confidence in these numbers - due to the fact that the studies on which they are based are dated and carried out by various researchers in a variety of places using different methods making comparisons difficult -, the numbers are substantial. This indicates, with a degree of confidence, that the non-consumptive direct use values of elephants are high.

Another way to value elephants is to estimate the minimum costs to sustain an elephant or elephant populations. This would normally provide a measure of minimum value. The minimum cost to conserve elephants in Luangwa Valley, Zambia during a time of intensive poaching was estimated at around $215 per km^2 in 1981 terms, and when adjusted for inflation amounts to $340 per km^2 in 1994 terms (Leader-Williams, 1994). Using the same average 4.5% annual increase in costs from 1981 – 2006 as used by Leader-Williams (1994), current cost levels are estimated at around $600 per km^2. Assuming desired density of two elephants per km^2 in savanna habitat – which is high - this amounts to a cost for elephant conservation of $300 per elephant or $150 million per annum. In relation to the number of households in Europe and the US this amounts to $1 burden per household per annum. These results should be interpreted with caution as only 32% of conservation success could be explained by spending levels in the original study (Leader-Williams, 1994:31). This implies that more spending, i.e. a bigger budget is insufficient to assure elephant conservation but that institutional factors and management practices are playing a significant role as well.

Once the need for migration of elephants across protected area boundaries into adjacent human-inhabited areas, the costs of protection will increase. In a study on the minimum cost of implementing a payments for ecosystem services (PES) scheme in the Amboseli National Park of Kenya it was estimated that Masaai farmers needed compensation equal to $10 per acre per year ($2,470 per km^2) for roaming elephant populations in their croplands (Bulte *et al*., 2006). For the 650 elephants of the Amboseli Park, this amounts to a compensation cost of $175 per elephant. Assuming that this study is representative of all African farmers confronted with elephants (a very strict assumption) and that all of the 500,000 elephants in Africa can migrate across protected area boundaries (a clear worst case

situation) this amounts to a maximum of $87.5 million per annum in compensation payments. For comparison, this amounts to a theoretical burden of $0.60 per household per annum for all European and US households, which implies that if all these households pay $0.60 per year, sufficient money could be collected to offset the damage caused by the elephants to crops. Care should be taken interpreting this number since it is based only on one sample and that of 650 elephants, but, indeed, it does indicate that the value from tourism (estimated above as $3.91 per European and US household per year) is significantly more than the damage cost caused by elephants. This appears to create a unique opportunity for the implementation of a payment for ecosystem goods and services system.

The cost of translocation is also an indication of the socio-political WTP for the conservation of elephants. In South Africa, costs of up to $2,850 per elephant were reported for translocation within the country (Wilderness Conservancy, no date). The total WTP for elephant relocation has not yet been estimated.

Verdin (1995) estimated the ivory value per elephant at $2,734 (1987 prices). According to a recent report by CWI (2007), ivory prices for unworked pieces ranged from US$121-900 (average $390) per kilogram. Another recent release by CITES stated that the black market value of African ivory is approaching a high of $700 per kilogram (Cites decision promotes illegal ivory trade 2007). It is well known that ivory per elephant is declining rapidly, and currently estimated at between 7 kg and 12kg of ivory per African elephant (van Kooten, 2005, Hunter *et al.*, 2004). Multiplying this with the price range of US$121-900 provides an estimate of $850 - $6300 per elephant. At an average price of $390/kg the current average value is estimated at around $2,725 per elephant. Given the illegal nature of the ivory trade, it is very difficult to estimate the number of elephants involved. Nevertheless, Hunter *et al*. (2004) used one set of data and careful extrapolation methods to estimate that the ivory from between 4,862 to 12,249 African elephants is required annually to supply the unregulated markets in Africa. Although it is only a best guess at this stage, this would imply a market of between a low of $4.1million and a high of $77.2 million annually. This represents a theoretical burden of between $0.03 and $0.51 per European and US household. The trophy

value of elephants was closely matched to the value of ivory and estimated at $2,366 at 1989 prices (Verdin, 1995).

Based on the information provided here with regard to studies conducted both in southern Africa and in the rest of the world, the next section will assess elephants' economic value in elephant-containing ecosystems and consider the economic instruments most plausible for their sustainable management.

Assessing elephants' contribution to the economic value of elephant-containing ecosystems

The suite of economic values of elephants are summarised in Table 10.7. Though these values are by no means definitive and are often based on outdated datasets and various assumptions, using different valuation techniques, a clear picture is appearing. The consumptive benefits (e.g., ivory, trophy hunting) of the African elephant are much less then its non-consumptive (e.g., tourism) and non-use (e.g., existence, option, and bequest) values. The stated WTP for the preservation of the African elephant for just the Swedish population ($57 million) is only 28% less than the high-end estimate for the value of the total ivory market ($77 million). If we hypothesize that this same WTP is shared by all European and American households - which are more or less on the same welfare level when compared to the average African household -, then the high-end value of the ivory market is only 3.5% of the potential Euro-North American WTP for the preservation of the African elephant. This analysis also points out that a compensation programme for both the direct damage costs of elephants to farmers and lost ivory income (a combined cost of $165 million per annum) is 7.5% of the estimated WTP for preservation by European and American households. Such a voluntary conservation aid programme would also save an additional $150 million in protection costs. Obviously, there can be but little confidence in the absolute level of these numbers, or how much of this market could actually be realised, or what South Africa's portion of it could be, but they are sufficiently high to indicate that options for alternative scenarios exist when considering the potential scope for the creation of a market for preservation of the African elephant.

Table 10.7: Summary of main economic values of African elephants

Type value	Comparative value per US & EU household (US $)[1]	Value per elephant (US $)[2]	Total estimated value per annum (US $)
Mainly existence, bequest and experience value	14.73	4 420	2.2 billion
Non consumptive tourism value	3.91	1 562	585 million
Protection costs against poaching	1	300	159 million
Compensation costs to surrounding land owners	0.60	175	87.5 million
Offsetting consumptive value of ivory	0.03 - 0.51	2 730	4.1 - 77.2 million
Consumptive value of trophy hunting	Na	2 360	Na
Translocation costs	Na	2 850	Na
Trade in live elephants[3]	Na	2 000 - 50 000	Na
Hunting values[3]	Na	40 000 - 70 000	Na

[1] For comparison all values are expressed in terms of 150 million European a and US households willing to pay, see Bulte et al., 2006 for a similar approach.

[2] Values adjusted to reflect 2006/07 estimates.

[3] These values, from the South African studies, are inflated due to the restricted market

The formally measured and accounted-for direct consumptive use values of the African elephant are low, as is to be expected given the heavy impact of the CITES ban. As noted by Barnes and his colleagues, the realised total economic value, excluding non-use values, of elephants have been reduced due to the CITES listing of elephants, probably by as much as 47%. Although the non-consumptive,

indirect, and non-use values of elephants is high (Vredin, 1997, Table 10.7), the CITES listing has reduced the real cash flow to both nation and communities. This is because there is currently no mechanism to retrieve, or capture, the non-use values. What is required are measures to protect, compensate, translocate, and even consume elephants, in a sustainable fashion, and, concurrently, for local communities, the nation, and the elephants to derive direct, measurable, and tangible benefits from all such activities. Within the development of such a "conservation, preservation and sustained use" market, and of institutions to support it, Far Eastern countries can likely play an important role, especially related to the direct "consumption" of elephant tusks. Additionally, if communities do not directly benefit from the presence of elephants, whether through consumptive or non-consumptive use or a combination thereof, indications are that they will not support elephant conservation in future (see the example of Zimbabwe). If, however, they are integrated, and made part of the "solution", then indications are that they would readily support conservation (see example from Namibia). The experiences of these countries offer South Africa excellent learning references.

What is also apparent now is that an inclusive conservation package that allows for all the possible economic benefits to be realised would be easily offset by the sum of economic benefits that could be gained. The challenge remains to create an efficient institution that would be able to capture these gains – i.e., the consumer surplus -, and distribute this to the benefit of both landowners and elephants. Evidence from all the studies cited previously suggests that international willingness to pay for elephant conservation in African countries exists, which implies that South Africa has a range of options to choose from. Barnes *et al.* (2002) supports this view ands states that much of the hitherto substantial international NGO and donor support for CBNRM is a form of non-use values. Additionally, contingent valuation studies among wildlife viewing tourists in Botswana and Namibia (Barnes, 1996b and Barnes *et al.*, 1999) revealed a significant willingness to pay for wildlife conservation. The surveyed tourists also had positive trip consumer surpluses; they were willing to pay more for their trips than they did, a view supported by South African studies as well (Turpie, 2003, Turpie and Joubert, 2001, Geach, 1997). This implies that the value they have received from viewing the wildlife is more than what the economic cost was of hosting them, implying that the

surplus, that constitutes an economic rent, "belongs" to the elephants and, if retained (captured) these rents could be used to advance conservation. At least a portion of the tourists' willingness to pay for conservation may thus come out of these surpluses, and may be defined as direct non-consumptive use value. It is important to note, however, that the estimated non-use values, as summarised in both Tables 10.5 and 10.7, are only hypothetical values. Until an institutional mechanism is created through which such values can flow and be materialised to the advantage of both people - through CBNRM or otherwise -, and elephants, and to the nation as a whole, they remain hypothetical.

Economists (e.g., Bulte *et al.,* 2006, Van Kooten and Bulte, 2000, Kahn, 1998, and Barbier *et al.,* 1990) seem to share the view that the use of markets through a well-designed institutional arrangement is a much better way of managing a precious resource over the long term, than an outright ban. This is since markets offer more management options and flexibility than command and control mechanisms. Barbier *et al*. (1990) summarise this thought very eloquently in the last paragraph of their book (Barbier *et al.,* 1990:147):

> *The future of the African elephant is dependent upon the taking of immediate action. The ivory trade ban must be considered an interim measure, not a solution. Sustainable populations of the African elephant, as with so many other endangered species, will depend upon the development of reforms which constructively utilize the trade, rather than attempts to combat it. Institutional reforms to this end must be addressed now.*

The development of market options have to be considered also from the perspectives that aid, especially predominant in East Africa, is not sustainable in the long run and cannot sustain or improve conservation (Van Kooten and Bulte, 2000, Norton-Griffith, 2007). A further stimulus for the development of markets is provided by the emergence of the Far Eastern marketsas significant roleplayers within the global ivory trade. This implies that the political-economic gridlock concerning the ban on trade in ivory cannot be maintained indefinitely. Leakage, i.e. both the legal and illegal trade in ivory, is likely to occur since sanctions and bans are imperfect measures to effect human behavioural change in the long run,

and such leakage will inevitably induce change. It is much more prudent to manage such change proactively and introduce the use of markets and incentives measures beforehand in a controlled environment than to be confronted with the effects of leakage. Since the economic system is a self-organising system (Krugman, 1996) that requires adaptive management, markets and incentive measures are much more efficient and effective to achieve a desired behavioural change if constituted and institutionalised appropriately than traditional command-and-control measures. In this context the use of market-based and command-and-control measures can occur in conjunction with each another for a period of transition allowing markets to operate within a controlled environment and, progressively, mature until they are fully fledged.

Time for such institutional change is ripe now. Almost two decades since the African elephant's listing as an endangered species, its numbers have increased by 50%. Concurrently, much experience has been gained to incorporate CBNRMs into the conservation framework and thereby distribute conservation benefits broadly, which could include the sustainable direct use or extraction of elephants (Damm, 2002). Such direct use will reduce the number of elephants, but, as has been observed in Botswana, the numbers are likely to be small, not exceeding 2000 per year at most. It should be noted that the sustainable use of elephants is, at least theoretically, not in conflict with the non-use values but could instead be an important compliment.

In parallel to the development of CBNRM and other institutional arrangements over the past 2 decades, much has been learnt since the late 1980s and early 1990s on how to establish and operate markets for ecosystem goods and services (Pagiola and Platais, 2007). Such a market would allow for the transfer of money, especially from Europe and the USA, to capture some of the non-use values of elephants. In so doing the economic value of elephants can be optimised by capturing all the values (direct consumptive, direct non-consumptive, indirect, and non-use values) and, additionally, release finances to both conserve the elephants, and increase their range to include human-occupied areas (Van Aarde and Jackson, 2007, Van Aarde *et al.*, 2006). This option would inject a new stream of income into rural communities, all across South Africa, especially those living in areas adjacent to

elephant containing ecosystems, and some of which even have a formal land claim on currently protected land. This offers a unique opportunity to link the formal (first) economy of South Africa with the informal (second) one, and to inject finances into the second economy by embracing the two as partners and fellow custodians of the natural environment and national heritage. This option is becoming increasingly viable due to current and probable future socio-demographic changes, as South Africa undergoes a rapid increase in urbanisation and de-population of the rural areas.

Conclusion

Some values of the African elephant are clearly expressed in the market, such as tourist expenditures on elephant viewing, or the direct costs of trophy hunting and the direct use benefits from elephants include ivory, although banned, and other animal products. However non-use values are not expressed or observed and hence difficult, but not impossible, to determine. One example of an unexpressed value is the willingness to pay to conserve certain species, such as elephants, for future generations on the part of many people who may never even see an elephant in their lifetimes. An interpretation of economic value thus goes beyond exchange values as measured through market-based transactions.

Though there are no studies on the total economic value of elephants in South Africa, there is a rich knowledge base thanks to work done in Botswana, Zimbabwe, and Namibia. Based on these studies, there is evidence of (i) an increase in the proportional contribution of non-consumptive values to the total economic value of elephants, but (ii) a decline in the overall economic value derived from elephants after the CITES ban on trading in elephant products. There is mixed evidence on the extent of elephant damage to local communities' crops and infrastructure from studies done in Botswana and Namibia. In some cases it was less than the damage by livestock, but in other cases substantial losses were incurred. Recall that in Kenya it was estimated that benchmark damage costs to Maasai amounted to $10 per acre per year or $2, 470 per km^2. In South Africa is it more than likely that this number is substantially less due to our formal elephant management system in

fenced-in conservation areas. A list of pertinent research questions with specific reference to South Africa is listed in Box 3.

Box 10.3: Key research questions

- What is the economic value of elephants in South Africa?
- What is the most appropriate, desirable, and feasible institutional arrangement and market mechanism to realise the suite of economic values of elephants?
- How could elephant markets, realising the direct, indirect, and non-use values of elephants, benefit local populations adjacent to elephant containing ecosystems?
- What are the likely impact of the emerging ivory market in the Far Eastern countries on South Africa and the impact thereof on the elephant management options for South Africa?
- How can markets be constructed to assist in reducing the risk and uncertainty in managing elephants and elephant containing ecosystems to the advantage of both elephants and people?

The success of institutions to compensate local communities, on the one hand, for their loss in income of elephant and elephant products and, on the other, for damage costs is also mixed. There is evidence of some success in distributing the economic value of conservation through CBNRM schemes in Namibia, but much less in Zimbabwe. The proper function of institutional success is a prerequisite for the effective internalisation of damages.

Based on evidence of international willingness to pay for the conservation of elephants, and the recent development 19 concerning markets for ecosystem goods and services, ways have to be found to internalise this expressed willingness to pay to advance the conservation of the elephant. Traditional policy options are limited in their scope of achieving this objective, but significant evidence exist that there is potentially sufficient international support to develop market-based alternatives. These high expressed non-use values for elephants basically are based on three factors, namely the fact that elephants exist, in other words that they *have to be preserved* for future generations, the ecological role they play within ecosystems, and the fact that people want to have the option to enjoy benefits from them in future. The preliminary meta-analysis presented in this chapter suggests that the non-use values from Europe and the US are 3 to 4 times higher than tourism values, 25 times higher then the benchmark compensation payments required to land owners, and almost 30 times higher than a high-end estimation of the total ivory market. There is therefore abundant scope for the creation of markets and institutional strengthening.

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