Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy

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Aggregate estimates for wildlife populations and species diversity on private land in Namibia were made for 1972 and 1992, using questionnaire surveys. Animal numbers and biomass appear to have increased by some 80%, or 3% per annum, over the period. The number of game species recorded increased by 44%. Cost-benefit analysis models were developed and used to analyse economic and financial efficiency of land use involving wildlife on private land. Financial profitability was generally low in the case of both livestock–game production for consumptive use and wildlife production for non-consumptive use. However these activities appear to be economically efficient, and result in a positive contribution to national income. The results suggest that there are financial incentives for private landholders to group together and form large scale conservancies. The latter benefit from economies of scale which make them more financially profitable and robust, and also more economically efficient, than ranches. Wildlife production for non-consumptive wildlife viewing yielded greater economic net value added per unit of land than livestock–wildlife production for consumptive use, particularly at the larger conservancy scale of operation. Aggregate estimates, in 1994 prices, of the annual net value added to national income from wildlife use on private land are N$ 30.6 million in 1972 and N$ 56 million in 1992. The economic value of wildlife use as a proportion of the total value of private land rangeland use has risen from 5% to 11% over the 20-year period. Current policy to promote both wildlife use and the development of wildlife conservancies on private land appears to be economically sound.

Keywords: economic, financial, Namibia, private land, value, wildlife

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Introduction

The aim of this study was to determine whether policy which promotes the development of wildlife uses on private land is economically sound or not. The development of wildlife-based land uses on commercial farmland in southern Africa is generally well documented. Legislative changes which bestowed custodial user rights over wildlife on private commercial landholders have resulted in increased wildlife stocks on commercial land (Joubert 1974; Luxmoore 1985; Child 1988; Cumming 1990; Jansen, Bond & Child 1992; Bond 1993). A measurable amount of land in these areas (mostly land that receives low rainfall and is marginal for livestock production) has been converted from livestock production to wildlife use. More recently there have been developments in which individual landholders have grouped together and are sharing management activities within conservancies. Du Toit (1994) describes how this has happened in Zimbabwe.

Adams, Werner & Vale (1990), World Bank (1992) and Quan, Barton & Conroy (1994) all describe Namibia's commercial farming sector in some detail. Some 43% of Namibia's land surface, or 356 886 km^2 is occupied by privately owned commercial farm land. This is concentrated in the semi-arid and arid centre and south of the country. Mean annual rainfall ranges from 550 mm in the north-east to 50 mm in the south-west. About half of the commercial land, in the northern parts where mean annual rainfall is above about 250 mm, is occupied by wooded savanna vegetation of several types, mostly dominated by *Acacia* spp. The other half, in the drier southern parts where rainfall is below 250 mm per annum, is dominated by karroid shrublands, in which *Rhigozum trichotomum* is common. The basic form of land use is extensive livestock production on ranches, with cattle dominating in the northern savannas and small stock, mostly sheep, dominating in the southern shrublands. Stock carrying capacities vary widely with climate, but long-term average capacities range from some 10 ha per large stock unit (LSU) in the north-east to some 35 ha per LSU in the south-west (P. Brand 1995 pers. comm.).

Individual ranch property sizes average some 8 000 ha in the northern savannas to some 10 000 ha in the southern shrublands. The numbers of cattle (on average 1 head = 1 LSU) on commercial land since 1972 have varied between 1.5 and 1 million with numbers generally having declined over the period. The numbers of sheep have also tended to decline over the period, ranging between about 3.9 and about 2.2 million (some 700 000 to 400 000 LSU equivalents). Goat numbers have fluctuated around half a million (some 80 000 LSU equivalents). The main commercial products are beef from cattle and mutton from sheep. Production of pelts from karakul sheep in the south has declined significantly in recent years as farmers have converted to mutton production.

Natural wildlife populations on commercial land are adapted to desert conditions (Kalahari and Namib). The generally open habitats in the south are dominated by springbok *Antidorcas marsupialis*, with lesser, associated populations of gemsbok *Oryx gazella* and kudu *Tragelaphus strepsiceros*. Kudu, gemsbok and warthog *Phacochoerus aethiopicus* dominate in the savannas of the north, with lesser associated populations of species such as hartebeest *Alcelaphus buselaphus*,

eland *Taurotragus oryx*, springbok and dik-dik *Madoqua kirkii*. Mountain zebra *Equus zebra hartmannae* occur in western scarplands and ostrich *Struthio camelus*, steenbok *Raphicerus campestris*, klipspringer *Oreotragus oreotragus* and duiker *Sylvicapra grimmia* tend to occur throughout. Generally the greatest diversity is found in the northern savannas, giraffe *Giraffa camelopardalis*, plains zebra *Equus burchelli* and blue wildebeest *Connochaetes taurinus* also occur here, and most game species introductions have taken place here. Populations of some of the larger predators, e.g. cheetah *Acinonyx jubatus*, leopard *Panthera pardus* and brown hyaena *Hyaena brunnea*, persist throughout.

Use of wildlife on private ranches has generally developed as a supplementary activity to livestock production but a small, yet increasing number of properties are devoted purely to wildlife production. Forms of use involve venison production through either organized night culling or informal shooting and selling, live game capture and dealing, selling of recreational hunting opportunities for either biltong or trophies, specialized semi-intensive ostrich farming and non-consumptive wildlife viewing tourism. The latter, in particular, tends to be associated with larger, better stocked, pure wildlife ranches. Generally, markets for these wildlife products appear large relative to the potential scale of production in Namibia which has a gross domestic product less than 2% of the region's total (World Bank 1992). Several studies (Joubert 1974; Joubert, Brand & Visagie 1983) have described the early development of wildlife use on commercial land in Namibia. These outlined rapid growth of trophy hunting activities, culling for venison production and recreational hunting for biltong.

Brand (1984) modeled the financial profitability of production of springbok, kudu, gemsbok, eland, cattle and karakul sheep on a 10 000 ha unit, comparing net farm incomes and discussing the integration of game into livestock ranching systems. In Botswana the production of game as a complementary component of livestock ranching systems is less risky and more profitable than production of game only (Barnes & Kalikawe 1994). This is primarily because pure game production is associated with relatively high capital investment costs (mainly stocking and enclosure costs) and poor market development.

In an analysis of the European market for exported Namibian venison Drew & Schwarting (1994) investigated the costs of venison production with the aid of two financial ranch models. One of the models depicted a typical cattle production system with supplementary game use in the savanna habitats in the north of the commercial farmlands. The other depicted a typical sheep production system also with supplementary game production in the southern karroid shrublands in the south of the commercial farm lands. These were financial spreadsheet models which provided a measure of the annual farm profitability (the net profit), and form the basis for some of the analysis in this study.

In 1972, 1982 and 1992, the Ministry of Environment and Tourism undertook three compatible questionnaire surveys of commercial farmers, asking farmers, among other things, to estimate the populations of various game species on their farms. The returns from these surveys can be used to get an indication of the trends in wildlife populations (numbers and species diversity) on commercial farmlands.

The data on ranch profitability have been used to develop dynamic financial and economic models for the two main ranch systems described above, and the questionnaire survey data were used to develop aggregate estimates of game animal populations and game biomass in the commercial farming areas. Other models were developed to determine the economic forces associated with the development of conservancies. Throughout the paper values are given in Namibia dollars (N$ 1 = Rand 1 = US$ 0.27).

Methods

Measuring wildlife populations

Aggregate estimates for game populations and diversity on commercial land were made for 1972, 1982, and 1992 and were based on three surveys of the status of game on farms, made during those years. These surveys involved postal distribution of a comprehensive self-administered questionnaire to all land occupiers in the commercial farm lands. The basic methodology used in 1972, as described by Joubert & Mostert (1975), was followed for ensuing surveys. Names and addresses were obtained from the internal revenue authorities. In the questionnaire, among other things, respondents were requested to record the presence and estimate the abundance of each game species occurring on their properties. Percentage questionnaire returns were 61%, 57% and 41% for the 1972, 1982, and 1992 surveys respectively.

For estimation of the total populations of each species on the properties we assumed that game densities on the land of farmers who did not respond were half of those who did respond. Joubert & Mostert (1975) used the sample itself (from 61% of the farms) as the estimate of total game numbers. Since, in the case of the 1992 survey, we know of a number of well stocked game farms, from which returns were not received, we consider that our method of estimation is more appropriate. Although the limitations of the methodology preclude statistical validation of trends, the values derived provide a useful indication of numbers, diversity and trends. All species numbers were converted to a standard unit of biomass, viz, the large stock unit (LSU) equivalent, using the method of Meissner (1982).

Measuring financial and economic efficiency

The efficiency of the wildlife use activities on commercial land was measured using cost-benefit models. These consisted of detailed spreadsheets, subjectively developed to represent typical examples of land use activities for relatively homogeneous regions. Data for the models were derived from farmer experience, detailed study of selected specific enterprises (Unpublished data, Directorate of Environmental Affairs), results from the 'mail-in' surveys of the Directorate of Planning, Pricing and Cooperatives (where over a number of years some 150 farmers submitted individual financial records to the directorate in return for aggregate and means for their sectors; C. van der Merwe 1993 pers. comm.) and other general statistics and sources. Rigorous sensitivity analysis was used to determine how robust the models and assumptions were, and the strength of any conclusions that could be drawn from the results.

The cost-benefit models measured value from two differ-

ing perspectives. Firstly the inherent *financial* profitability of the activity determines whether there is a financial incentive for resource users to invest in the activity. The financial model provided an estimate of the annual net cash income in a static format, the financial internal rate of return over five and 10 years and the financial net present value over five and 10 years, in terms of the prevailing prices in the marketplace. Secondly the *economic* value of the activity determines whether the activity contributes to the overall welfare of society and the nation. In this process we determined the net contribution of the activity (positive or negative) to the national economy in terms of national income. The economic model provided an estimate of the annual value added and the annual net value added to the economy in a static format, as well as the economic internal rate of return and the economic net present value both over 10 years. It involved use of economic (shadow) prices which commonly differ from the financial ones referred to above. The values applied to inputs and outputs were those considered to reflect their real scarcity in society. They reflect the cost to society of resources being used in these activities and not in any other activities or sectors of the economy.

Since there were no general shadow pricing criteria for Namibia, we used the preliminary ones adopted by the Directorate of Environmental Affairs. These are adapted, to a large extent, from the approach of Gittinger (1982) and manuals developed for South Africa and Botswana (CEAS 1989; Ministry of Finance & Development Planning 1986).

We assumed a shadow price for unskilled and semi-skilled labour of 0.35 of the market price. This was derived by taking the average of the below average shadow wages (rather than the overall average) given by CEAS (1989) for South African development regions and comparing them with farm wages recorded for Namibia (C. van der Merwe 1993 pers. comm.). Because there is very little unemployment among skilled workers and professionals in Namibia, financial costs for skilled worker wages and salaries were assumed to equal their shadow prices.

Effects of domestic taxes and subsidies on market prices were removed to get economic prices. Input subsidies for commercial livestock production have now been largely eliminated (C. van der Merwe 1993 pers. comm.) and only taxes (general sales tax and the more selective sales duty) have any effect on financial prices in the models. We adjusted all tax-inclusive prices down by a flat 11% rate to compensate for this.

All imports to Namibia from outside the Southern African Customs Union (SACU) have been subject to customs duties or tariffs, paid into a SACU revenue pool from which revenue payments are made to Namibia. We assumed that SACU receipts (economic benefits) approximated the tariff payments (economic costs). However, the SACU tariffs have a protection effect which almost certainly influences prices of all or most Namibian imports including even South African manufactured products. We accounted for this protection effect through application of a foreign exchange premium as discussed below.

We added a foreign exchange premium of 12% to the prices of all tradable items to account for excess demand for these goods and services within Namibia. The premium was determined taking into account the effects of the dual exchange rate system for the Namibia Dollar (now abolished), the likelihood of continued decline in the relative value of the currency, the fact that there has been no growth in Namibian fixed capital stock since the early 1980s, and the apparent protection effect of SACU tariffs. We also considered the foreign exchange premiums recommended by others in Zimbabwe and Botswana (Jansen *et al.* 1992; Matambo 1988).

Inflation was excluded from all models and financial and economic net benefit flows were discounted, in real terms, to reflect the time value of money. Recommendations for discount rates in Botswana (Ministry of Finance & Development Planning 1986; Matambo 1988) and South Africa (CEAS 1989), the conditions of inflation and capital availability in these countries and in Namibia, and the apparent need in Namibia to encourage labour intensive private sector investment, led us to select a basic real discount rate of 8% for both financial and economic analyses. Rates of 6% and 10% were also applied in sensitivity analysis.

In the financial models the value of land is reflected, as a cost, in rentals which, in turn, reflect the purchase value. This is treated as a domestic transfer and excluded in the economic analysis. Our economic measures are thus made before inclusion of land opportunity costs (i.e. the economic cost of land is assumed to be zero for all models). The economic models also excluded central government expenditures in the wildlife and agriculture sectors, because these expenditures are extremely difficult to allocate correctly, and also because it is conventional to treat the public sector separately in national income accounts.

Economic analysis should take account of any consequential changes in consumer surplus. In Namibia, some 70% of leisure tourists are non-citizens (Hoff & Overgaard Planning Consultants 1993), and most venison produced is exported (Drew & Schwarting 1994). Since most output modeled in this paper was for export, we felt able to ignore any consumer surplus changes (since most would leave national income unaffected).

Measuring aggregate economic value

The results of the economic land use cost benefit models were applied to aggregate biomass figures to provide an estimation of the overall annual contribution of wildlife use as net value added to national income. The values for consumptive wildlife use within livestock–game ranch scale systems, described below as Models 1 and 2, were used. The economic net value added through wildlife use per LSU equivalent of wildlife stock biomass (on the land) was multiplied by the total LSU biomass figures for private land. The same method was applied to determine livestock values.

Land use systems analysed

We examined three basic farm scale models and two conservancy scale models in an attempt to identify economic forces affecting wildlife use on commercial land. Two of the ranch systems represent typical livestock production enterprises incorporating supplementary wildlife cropping and trophy hunting. One is representative of the northern, wooded savanna farm land area, and the other is representative of the southern, karroid shrub savanna farm land areas. A third farm

scale model, set in the northern savanna, involves a pure wildlife operation, where the land is stocked with a relatively diverse population of wildlife and income is derived through a medium-scale wildlife-viewing lodge.

Two models depicting conservancies in the northern, savanna farmland areas were developed. One represents a grouping of 10 cattle–game production ranches similar to the ranch scale model of this type. The other represents an amalgamation of seven pure wildlife ranches similar to the ranch scale model of this type, aimed at non-consumptive wildlife viewing.

The southern mixed sheep and game ranch system (Model 1) involved dorper sheep breeding for lamb production, combined with use of springbok and some gemsbok and kudu for culling, trophy hunting, biltong hunting and own use. The ranch size was 11 520 ha, the initial capital investment was N$ 1.6 million and sheep made up 88% of the animal biomass, stocked at a rate of 32 ha per LSU equivalent. Off-take rates were those possible with a reasonable amount of herd management, viz, 60% for sheep, 27% for springbok, 16% for gemsbok, and 17% for kudu. Eighteen trophy hunter days were assumed to be sold per annum and 13% of the game off-take was taken as trophies. The staff requirement consisted of four unskilled labourers and one semi-skilled labourer besides the owner-manager. A land rental cost to the farmer of N$ 0.78 per hectare was assumed.

The northern mixed cattle and game ranch system (Model 2) involved beef cattle breeding and rearing for slaughter, combined with use of gemsbok, kudu, some springbok and some warthog for culling, trophy hunting, biltong hunting and own use. The ranch size was 9 024 ha, the initial capital requirement was N$ 1.6 million and cattle made up 75% of animal biomass, stocked at a rate of 14 ha per LSU equivalent. Off-take rates were those possible with a reasonable amount of herd management, viz, 25% for cattle, 16% for gemsbok, 17% for kudu, 27% for springbok and 10% for warthog. Thirty trophy hunter days were sold per annum and 15% of the game off-take was taken as trophies. The staff requirement consisted of six unskilled labourers and one semi-skilled labourer, besides the owner-manager. A land rental cost to the farmer of N$ 0.89 per hectare was assumed.

The third ranch model (Model 3) was also set in the northern savanna, and involved production of a diverse community of game for non-consumptive wildlife viewing. The ranch size was 14 401 ha and the initial capital required was N$ 3.2 million. This was largely made up of the costs of stock purchase, fencing and lodge construction, and 25% of the capital was assumed to be financed from foreign sources. Some 12 species, including black-faced impala *Aepyceros melampus petersi*, eland, gemsbok, giraffe, hartebeest, kudu, plains zebra, springbok, roan *Hippotragus equinus*, blue wildebeest, warthog and white rhino *Ceratotherium simum* were assumed to be present, stocked at a rate of 20 ha per LSU equivalent. The 18-bed lodge had a daily tariff of N$ 375, an annual occupancy of 40% and catered to up-market clients, some 60% of whom were from overseas. Staff requirements consisted of 15 unskilled labourers, three skilled labourers and two managers besides the owner-manager. A land rental cost of N$ 0.89 per hectare was assumed.

The first conservancy model (Model A) consisted of 10 units of the northern cattle–game ranch system (Model 2), within which farmers managed their game in combination, but retained individual management of their livestock. Conservancy size was 90 239 ha and the initial capital amounted to N$ 12.8 million. The system made possible some economies of scale with regard to wildlife investments and management, in particular, fencing costs were reduced, through both sharing and the need for one less strand on internal fences. Greater diversity of shared species and greater scale of operation allowed improvement of the value of the trophy hunting by 30%.

The second conservancy model (Model B) consisted of 10 units of the northern pure game ranch (Model 3) within which farmers were assumed to manage their game in combination for wildlife viewing, through seven lodges and tented camps with a combined bed capacity of 126 beds. Conservancy size was 100 809 ha and the initial capital investment was N$ 18.2 million. The system made possible some economies of scale with regard to wildlife investments and management, in particular, fencing costs were reduced. The larger scale allowed the stocking of a greater diversity of species so that mountain zebra, sable *Hippotragus niger*, tsessebe *Damaliscus lunatus* and black rhino *Diceros bicornis* or elephant *Loxodonta africana* were assumed to be present in addition to those listed for Model 3. This made for a better tourism product and made it possible for accommodation tariffs to be an estimated 7% higher than they were in Model 3.

Results

Wildlife populations

Table 1 shows the changes in game populations estimated and diversity of game species recorded between 1972 and 1992, based on the two questionnaire surveys of those years. Data from the 1982 survey generally showed values intermediate between those of 1972 and 1992 and have been left out for simplicity.

Wildlife numbers appear to have increased by some 70% over the 20-year period between 1972 and 1992, and similarly, the biomass of game appears to have increased by some 84% (Table 1). There appears to have also been an increase of some 44% in the diversity of species. In 1972 only one subspecies, the impala *Aepyceros melampus melampus*, was not indigenous to the commercial farm land areas, although it did occur in the north-eastern Caprivi region of Namibia. In 1992 five new species, black wildebeest *Connochaetes gnou*, nyala *Tragelaphus angasii*, reedbuck *Redunca arundinium*, sable and tsessebe, were not indigenous to the commercial farm land areas, and two of these (black wildebeest and nyala) are exotic species in Namibia. In addition, one species recorded in 1992 under miscellaneous, the blesbok *Damaliscus dorcas phillipsi* is exotic.

Financial and economic efficiency

Table 2 shows the basic *financial* characteristics for the three ranch scale financial models analysed, viz, the southern sheep with game system, the northern cattle with game system, and the northern non-consumptive game system. The results generally indicate that ranching systems on private land in Namibia have low profitability. All systems have financial rates of return below the 8% discount rate and the net present

Table 1 Estimates[a] of game numbers and biomass by species for all private land (commercial land) in Namibia in 1972 and 1992, based on questionnaire surveys made during those years

	1972		1992	
Species	No. head	No. LSU[b]	No. head	No. LSU[b]
Black wildebeest	–	–	7 177	2 009
Black-faced impala	–	–	2 144	300
Blue wildebeest	326	130	4 935	1 974
Dik-dik	13 011	520	15 783	631
Duiker	84 419	6 753	75 518	6 041
Eland	10 338	10 338	29 150	29 150
Gemsbok	55 406	22 163	164 306	65 722
Giraffe	3 760	5 039	4 552	6 099
Hartebeest	16 302	4 076	50 804	12 701
Impala	1 006	141	4 919	689
Klipspringer	29 509	1 770	22 879	1 373
Kudu	148 211	59 285	203 087	81 235
Mountain zebra	22 531	13 519	34 398	20 639
Nyala	–	–	96	19
Plains zebra	1 214	765	4 170	2 627
Reedbuck	–	–	2 303	322
Roan	–	–	633	380
Sable	–	–	6 804	2 722
Springbok	221 955	22 195	286 113	28 611
Steenbok	18 741	1 124	138 941	8 336
Tsessebe	–	–	1 564	422
Warthog	67 207	12 097	121 250	21 825
Miscellaneous[c]	5 293	1 164	12 514	2 753
Total	699 227	161 080	1 194 042	296 583
Number of species	16		23	

[a] Conservative estimates, assuming that densities of game on land of non-respondents was half those of respondents

[b] Large Stock Unit equivalents calculated using method of Meissner (1982)

[c] Miscellaneous other species, dominated primarily by two: ostrich and blesbok.

Table 2 Key financial characteristics for three ranch scale land use systems on private land, involving wildlife (N$, Namibia 1994)

	Land use system[a]		
	1. Southern sheep/game	2. Northern cattle/game	3. Northern game lodge
Ranch extent (hectares)	11 520	9 024	14 401
Stock on hand (no. LSU)	360	668	465
Static financial measures[b]			
Initial capital investment	1 553 151	1 565 542	3 189 813
Capital investment per hectare	135	173	222
Annual gross income	309 638	257 125	1 000 283
Gross income per hectare	27	28	69
Annual variable costs	78 663	66 281	317 548
Variable costs per hectare	7	7	22
Annual fixed costs	167 172	153 403	553 615
Fixed costs per hectare	15	17	38
Annual net cash income	63 803	37 442	129 120
Net cash income per hectare	6	4	9
Annual return on initial capital	4%	2%	4%
Financial worth over 10 years			
Financial Rate of Return	5.8%	3.9%	4.2%
Financial Net Present Value (@ 8%)	-184 984	-364 187	-718 306
Net Present Value per hectare	-16	-40	-50

[a] 1. Southern sheep production with supplementary game use for venison and trophies
2. Northern cattle production with supplementary game use for venison and trophies
3. Northern game production and lodge development for non-consumptive wildlife-viewing tourism (see also text)

[b] Measured after enterprise has attained stability (full production)

values over 10 years are negative. The southern sheep–game system appears to be more profitable than the northern cattle–game system. It is of interest to note that in both systems the livestock production component had higher gross margin (return to fixed costs) than the game production component (Drew & Schwarting 1994). The pure game wildlife viewing ranch system (Model 3) involves both investment and turnover (gross income) which are significantly higher than those of the other two systems. It does not, however, appear to offer a better incentive for investment than Model 2 for the northern savannas.

Table 3 shows the *economic* characteristics for the three ranch models. The economic rates of return of all are higher than the discount rate of 8% and the economic net present values over 10 years are positive. This indicates that all are economically efficient, and as such are deserving of support in policy. Another point of interest indicated by the results is that, of the two northern savanna systems, the pure wildlife ranch (Model 3) has greater economic profitability and a higher net economic contribution per unit of land. This is likely to be due, in part, to the fact that the wildlife viewing production system is relatively labour intensive.

Table 4 shows the financial characteristics for the two conservancy scale models, A and B. The results here can be compared directly with those for the two northern savanna models in Table 2 (Models A and B) to determine if the larger scale results in greater efficiency. This indeed, appears to be the case since the financial rates of return for both conservancy systems are more than twice as high as those for the ranches practising the same land uses. That for the pure wildlife system is also above the 8% discount rate and the system thus has a positive financial net present value over 10 years. It can be seen that capital investment per hectare is lower for the conservancies than it is for the ranches. Similarly, with the conservancies, gross income is higher and fixed costs are lower per unit area.

Table 5 shows the economic characteristics for the two conservancy systems. In both cases the economic rate of return is well above the discount rate of 8% and both investments have positive economic net present values over 10 years. The 10 year net present values and also the annual net value added contributions generated per unit of land, in both systems are higher than those for the individual ranch models

Table 3 Key economic characteristics for three ranch scale land use systems on private land, involving wildlife (N$, Namibia 1994)

	Land use system[a]		
	1. Southern sheep/game	2. Northern cattle/game	3. Northern game lodge
Ranch extent (hectares)	11 520	9 024	14 401
Stock on hand (no. LSU)	360	668	465
Static economic measures[b]			
Initial economic capital investment	1 491 165	1 473 342	3 039 111
Economic capital investment per hectare	129	163	211
Economic capital investment per job created	298 233	210 477	144 720
Annual economic gross income	308 647	256 303	976 558
Economic gross income per hectare	27	28	68
Annual economic costs	73 205	67 334	538 123
Economic costs per hectare	6	7	37
Annual gross value added [c]	235 442	188 969	438 434
Gross value added per hectare	20	21	30
Annual net value added [c]	157 116	129 635	270 125
Net value added per hectare	14	14	19
Return in net value added/initial capital	10.5%	8.8%	8.9%
Economic worth over 10 years			
Economic Rate of Return	10.8%	8.5%	13.6%
Economic Net Present Value (@ 8%)	223 301	40 992	963 018
Net Present Value per hectare	19	5	67

[a] 1. Southern sheep production with supplementary game use for venison and trophies
2. Northern cattle production with supplementary game use for venison and trophies
3. Northern game production and lodge development for non-consumptive wildlife viewing tourism (see also text)

[b] Measured after enterprise has attained stability (full production)

[c] Gross value added to national income less depreciation = net value added to national income.

(Models 2 and 3 in Table 3). Comparison between the measures in Tables 3 and 5 reveals that the greatest difference between the conservancy and ranch models is in the initial economic capital investment requirements, which are almost 20% lower per hectare for the conservancies. The results in Table 5 again suggest that pure wildlife ranching for up-market wildlife viewing, where it occurs, can contribute more to the economy, per unit of land, than livestock and wildlife production for consumptive use.

The results obtained from cost benefit analysis models are dependent to a high degree on the assumptions used in their formulation. Sensitivity analysis, where key assumptions are varied to determine the effect on results, allows us to get a feel for the reliability and validity of the results. The land use system models in this paper have been subjected to this process. Table 6 shows the effect of variation in product prices on the financial and economic profitability of the ranch and conservancy systems modeled. The conservancy systems, as might be expected since they are more profitable, are generally less sensitive than the ranching models. However, with respect to financial profitability, of the two northern savanna production systems, the pure wildlife system (Models 3 and B) appears consistently less able to withstand a drop in prices than the cattle–game system (Models 2 and A). Where economic profitability is concerned the opposite is evident with the pure wildlife system appearing to be more robust.

Table 7 shows results of sensitivity analysis where the price of initial capital items has been varied. This could happen if for example the auction price of stock was to increase or the costs of fencing or water provision were to increase. The financial profitability of the pure game system (already a capital intensive system) emerges, again, as more sensitive to capital price increase than the livestock game systems. This is, however, not the case with economic profitability, where the pure game system emerges as being apparently less sensitive.

Sensitivity analyses with regard to other key assumptions in the models show the sensitivity of the three systems with consumptive off-take (Models 1, 2 and A) to changes in herd off-take rates. If no herd management (with deliberate herd sex ratio manipulation) was done, off-take rates could be expected to fall to about 60% of those assumed in the models. The off-take rates in the southern and northern ranch scale systems (Models 1 and 2) could drop to 64% and 68% of those assumed, respectively, before the financial rate of return became negative. For the conservancy cattle–game system in the northern savanna (Model A) the off-take rates could drop lower, to 49% of assumed rates, before the rate of return became negative. In economic terms the enterprises are more robust in the face of dropping off-take rates. Systems 1, 2 and A could withstand drops in off-take rates to 44%, 43% and 29% respectively.

Table 4 Key financial characteristics for two conservancy scale land use systems on private land, involving wildlife (N$, Namibia 1994)

	Land use system[a]	
	A. Northern cattle/game	B. Northern game lodge
Conservancy extent (hectares)	90 239	100 809
No. of ranch units	10	7
Stock on hand (no. LSU)	6 684	3 255
Static financial measures [b]		
Initial capital investment	12 847 242	18 188 620
Capital investment per hectare	142	180
Annual gross income	2 627 223	7 453 967
Gross income per hectare	29	74
Annual variable costs	650 549	2 182 817
Variable costs per hectare	7	22
Annual fixed costs	1 211 442	3 328 932
Fixed costs per hectare	13	33
Annual net cash income	765 232	1 942 218
Net cash income per hectare	8	19
Annual return on initial capital	6.0%	10.7%
Financial worth over 10 years		
Financial Rate of Return	7.3%	10.0%
Financial Net Present Value (@ 8%)	-513 026	2 307 136
Net Present Value per hectare	-6	23

[a] A. Northern cattle production with supplementary game use for venison and trophies

B. Northern game production and lodge development for non-consumptive wildlife-viewing tourism (see also text)

[b] Measured after enterprise has attained stability (full production)

Table 5 Key economic characteristics for two conservancy scale land use systems on private land, involving wildlife (N$, Namibia 1994)

	Land use system [a]	
	A. Northern cattle/game	B. Northern game lodge
Conservancy extent (hectares)	90 239	100 809
No. ranch units	10	7
Stock on hand (no. LSU)	6 884	3 255
Static economic measures [b]		
Initial economic capital investment	11 974 722	17 161 014
Economic capital investment per hectare	133	170
Economic capital investment per job created	190 075	129 713
Annual economic gross income	2 618 816	7 276 792
Economic gross income per hectare	29	72
Annual economic costs	596 884	3 735 371
Economic costs per hectare	7	37
Annual gross value added [c]	2 021 931	3 541 421
Gross value added per hectare	22	35
Annual net value added [c]	1 619 541	2 630 815
Net value added per hectare	18	26
Return in net value added/initial capital	13.5%	15.3%
Economic worth over 10 years		
Economic Rate of Return	12.9%	19.5%
Economic Net Present Value (@ 8%)	3 391 193	11 782 437
Net Present Value per hectare	38	117

[a] A. Northern cattle production with supplementary game use for venison and trophies

B. Northern game production and lodge development for non-consumptive wildlife-viewing tourism (see also text)

[b] Measured after enterprise has attained stability (full production)

[c] Gross value added to national income less depreciation = net value added to national income

The two land use systems involving wildlife only for non-consumptive wildlife viewing (Models 3 and B) were tested for their sensitivity to changes in tourist occupancy rates below those assumed (40% in both models). The financial rate of return became negative for the ranch scale system (Model 3) when occupancies dropped below 32%. The conservancy scale system (Model B) could withstand a drop in occupancy rate to 25%. In terms of economic profitability the ranch and conservancy systems could withstand drops in occupancy rates to 14% and 11% respectively. Sensitivity analysis also included application of different discount rates. Besides the basic rate of 8%, rates of 6% and 10% were applied to all models. Generally, the results of discount rate sensitivity tests were comparable with those for the basic rate, although the low and high variants increased and decreased financial and economic profitability, respectively. The northern mixed cattle and game ranch system (Model 2) was rendered economically non-viable with application of a 10% discount rate and the northern cattle–game ranch system (Model A) was rendered financially non-viable with a 10% discount rate.

Table 8 shows the degree to which financial values were found to differ from the economic ones in the three ranch scale land use systems (Models 1, 2 and 3). It gives an indication of which financial prices have been distorted from their economic values as a result of policy and/or market imperfections, and by how much. A policy analysis matrix was employed, similar to that used by Jansen *et al.* (1992). The effect is determined from the point of view of the farmer and is derived, firstly, for benefits (gross output and net income or net present value) by subtracting economic values from financial ones and, secondly, for costs (tradable input and domestic factors) by subtracting financial values from economic ones. The effects of policy and market imperfections is positive for all models with regard to gross income or output values. This means that financial product prices are higher than the real scarcity value of these products to society. The prices are mainly distorted upwards by inclusion of sales tax. This is despite the fact that the financial prices of tradable products are distorted below real values by the foreign exchange premium. With regard to tradable input costs, financial values are lower than economic ones for the two livestock–game systems (Models 1 and 2). This is also due to the effect of sales tax. In the case of the pure wildlife system (Model 3) tradable inputs have higher economic than financial value, primarily because of the foreign exchange premium and pay-

Table 6 Sensitivity of the financial and economic profitability of ranch and conservancy systems involving wildlife, to reductions in product prices (Namibia, 1994)

	Product price drop required to make financial or economic rate of return negative (% change)	
	Financial model	Economic model
Ranch scale land use systems [a]		
1. Southern sheep and game production	–30%	–47%
2. Northern cattle and game production	–26%	–46%
3. Northern game-viewing lodge	–17%	–59%
Conservancy scale land use systems [b]		
A. Northern cattle and game production	–41%	–59%
B. Northern game-viewing lodge	–33%	–66%

[a] 1. Southern sheep production with supplementary game use for venison and trophies

2. Northern cattle production with supplementary game use for venison and trophies

3. Northern game production and lodge development for non-consumptive wildlife-viewing tourism

[b] A. Northern cattle production with supplementary game use for venison and trophies

B. Northern game production and lodge development for non-consumptive wildlife-viewing tourism

Table 7 Sensitivity of the financial and economic profitability of ranch and conservancy systems involving wildlife, to increases in capital item prices (Namibia, 1994)

	Capital price increase required to make financial or economic rate of return negative (% change)	
	Financial model	Economic model
Ranch scale land use systems [a]		
1. Southern sheep and game production	77%	143%
2. Northern cattle and game production	71%	151%
3. Northern game-viewing lodge	52%	360%
Conservancy scale land use systems [b]		
A. Northern cattle and game production	166%	280%
B. Northern game-viewing lodge	134%	543%

[a] 1. Southern sheep production with supplementary game use for venison and trophies

2. Northern cattle production with supplementary game use for venison and trophies

3. Northern game production and lodge development for non-consumptive wildlife-viewing tourism

[b] A. Northern cattle production with supplementary game use for venison and trophies

B. Northern game production and lodge development for non-consumptive wildlife-viewing tourism

ments to foreign investors.

For domestic factors in Table 8, the financial costs are much higher than the economic costs. This is because many of the domestic financial costs are transfers (sales tax, market

Table 8 Effects of policy and market imperfections on three ranch scale land use systems involving wildlife on private land (N$, Namibia 1994)

	Land use system [a]		
	1. Southern sheep/game	2. Northern cattle/game	3. Northern game lodge
Ranch extent (hectares)	11 520	9 024	14 401
Stock on hand (no. LSU)	360	668	465
Effect of policy and market imperfections [b]			
On gross output	991	823	23 725
On tradeable inputs	-129	-113	132 509
On domestic factors	-94 175	-92 903	-297 239
Net effect of policy and market imperfections [b]			
On annual net income	-93 314	-92 193	-141 005
On Net Present Value 8% (10 years)	-408 215	-405 178	-1 681 324

[a] 1. Southern sheep production with supplementary game use for venison and trophies

2. Northern cattle production with supplementary game use for venison and trophies

3. Northern game production and lodge development for non-consumptive wildlife-viewing tourism (see also text)

[b] From a policy analysis matrix as described by Jansen *et al.* (1992); measures the difference between financial and economic values in the land use activities, as manifested from the point of view of the resource user

fees, land rental, interest) which do not change national income, and also because of the distortion of financial wage costs above the opportunity costs for labour. The net effect of policy and market imperfections (effect on profits) is also negative for the farmer and attributable to these reasons.

Aggregate economic value of wildlife use

Table 9 shows the estimated contribution of all wildlife use on private land in terms of annual net value added to the national income. This is provided for 1972 and 1992. Sub-estimates are also provided for the southern shrublands and the northern savannas. The total annual net contribution appears to have risen from some N$ 31 million to some N$ 56 million between 1972 and 1992. The portion attributable to the northern savannas was estimated to be consistently some 72% of this. The annual net value added per square kilometre was more than twice as high in the northern savannas than in the southern shrublands, despite the finding that wildlife populations in the south apparently contribute almost 60% more per LSU.

Using the same method as we did for wildlife we estimated the net value added attributable to livestock on private land for 1972 and 1992. The estimates amounted to N$ 583 million and N$ 448 million respectively. In 1972 the economic value of wildlife use would have been 5% of the value of livestock production and, also, 5% of the value of all rangeland use. In 1992 wildlife use would have had an economic value amounting to 13% of the value of livestock production, and 11% of the value of all rangeland use.

Table 9 Estimation of the annual net contribution to the economy of wildlife use on private land in Namibia in 1972 and 1992 (N$, 1994)

	1972	1992
Northern, predominantly cattle producing land [a]		
Total number of properties	2 757	2 757
Total extent (square kilometres)	192 237	192 237
No. of wildlife Large Stock Unit (LSU) equivalents	129 980	242 318
Annual net value added to national income per LSU	170	170
Total net value added owing to wildlife use	22 096 600	41 194 060
Net value added by wildlife per square kilometre	115	214
Southern, predominantly sheep-producing land [b]		
Total number of properties	1 703	1 703
Total extent (square kilometres)	164 650	164 650
No. of wildlife Large Stock Unit (LSU) equivalents	31 100	54 265
Annual net value added to national income per LSU	275	275
Total net value added owing to wildlife use	8 552 500	14 922 875
Net value added by wildlife per square kilometre	52	91
All private land		
Total number of properties	4 460	4 460
Total extent (square kilometres)	356 886	356 886
No. of wildlife Large Stock Unit (LSU) equivalents	161 080	296 583
Annual net value added to national income per LSU	190	190
Total net value added owing to wildlife use	30 649 100	56 116 935
Net value added by wildlife per square kilometre	85	157

[a] Land in following districts: Tsumeb, Grootfontein, Outjo, Otjiwarongo, Omaruru, Karibib, Okahandja, Windhoek and Gobabis

[b] Land in following districts: Mariental, Maltahöhe, Lüderitz, Bethanie, Keetmanshoop and Karasburg

Discussion and policy implications

The results above confirm commonly made assertions that wildlife numbers and diversity on private land have been increasing over the last 20 years. Increase in numbers and biomass appears to have been some 3% per annum over the period. Private landholders have sought to increase diversity to the point that several species not indigenous to the land or even Namibia have been introduced. One can assume that this has had the effect of enhancing wildlife use values, particularly for trophy hunting and wildlife viewing. Generally the increase in wildlife stocks and diversity will also have enhanced conservation values, but to an unknown extent these may have been jeopardized through the introduction of aliens and genetic pollution.

The results of the financial analysis generally confirm findings of Barnes & Kalikawe (1994), Jansen *et al.* (1992), Bond (1993), Behr & Groenewald (1990), Conybeare & Rozemeijer (1991) and others regarding the relatively low financial profitability of ranching on private land in southern Africa. The results of the economic analysis on the other hand suggest that all the activities are economically efficient and thus deserving of consideration of support in policy. Consumptive wildlife use in the south is more financially and economically profitable than in the north. This is primarily due to the higher value of springbok night culling activities in the south, relative to those for gemsbok and kudu in the north. This is in agreement with the findings of Brand (1984) and is mainly because springbok venison has higher value.

The results suggest that there is little financial incentive for individual farmers practising livestock and game production systems to convert to pure game production either for consumptive or non-consumptive use. However, pure wildlife production for wildlife viewing may well have an economic advantage over livestock–game production. The results clearly suggest that production at larger scale within conservancies is likely to be more efficient both financially and economically than production at ranch scale. There would appear to be a financial incentive, albeit weak, for the conversion of conservancies producing both livestock and game for consumptive purposes to conservancies producing wildlife only for non-consumptive purposes. There would appear to be a rather strong economic advantage to be gained from promotion of this type of conversion, where it is possible.

Several considerations might strengthen the findings made above. As described by Swanson & Barbier (1992), the total economic value of natural resources includes both use and non-use values. Use values can be direct or indirect. Non-use values are public goods and commonly reflect values perceived by society for the existence of resources (existence values) or the option to use them later (option values). The economic characteristics described in preceding paragraphs are restricted to direct use values. If indirect use values and non-use values had been included in the analysis they would most likely have enhanced the economic worth of the pure game systems, particularly those of larger scale with greatest diversity of wildlife. On the other hand, future implementation of the international General Agreement on Tariffs and Trade (GATT) will be likely to result in lower prices for Namibian livestock products (Low 1994) and this will lower the relative worth of systems involving livestock.

Other considerations might weaken the findings in this paper. The formation of conservancies involves common instead of individual decision making. This is likely to result in transaction costs which increase with the number of participants, and which have not been included in the analysis above. They are likely to reduce the general worth of large conservancies, relative to small ones and individual ranches. Also worthy of note is an apparent trade-off between cost reduction and income enhancement associated with conservancies. Fencing cost reductions are greatest with compact groups of farms, while incomes are increased with wildlife diversity which is greatest with extended or scattered groups of farms.

Safari hunting on private land appears to have had an interesting role in that it has been particularly profitable, but only as a supplementary enterprise alongside livestock or other wildlife land uses. Its profitability appears, on livestock farms, to have provided the financial incentive for much investment in wildlife and this, in turn, has led to conditions where conversion to pure wildlife ranching was possible.

The extent to which conversion from livestock–wildlife consumptive uses to non-consumptive wildlife-viewing use is possible, has limits. It will be constrained by the rate of change in overall demand for wildlife viewing, southern African competition in the supply of wildlife-viewing products,

and the fact that some private land simply cannot produce an attractive wildlife-viewing product. Thus, the range of substitution is limited and what is economically desirable at the current scales of resource use may not be so at different scales. Future economic analysis should make it possible to adjust policy accordingly.

The aggregate economic value of wildlife use on private land would appear to have risen by some 80% in real terms between 1972 and 1982. As a percentage of the net value added to national income resulting from all rangeland use on private land, the value attributable to wildlife appears to have risen from 5% to 11%. The government capital and recurrent expenditures on wildlife on private land are very unlikely to have exceeded N$ 8 million per annum at any time between 1972 and 1992 (N. Patching 1995 pers. comm.). Given the estimated annual economic contribution from private land wildlife (N$ 30 to 56 million), this expenditure seems to have been a very sound investment. The Ministry of Environment and Tourism currently supports both the use of wildlife and the development of wildlife conservancies on private commercial land. The results of this analysis suggest that this policy is currently economically sound and that it deserves general support within government.

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